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Cunard Liner Aquitania

A Giant Liner Intended to Maintain Express Service With the Lusitania and Mauretania

THE Cunard liner Aquitania intended to maintain with the Lusitania and Mauretania the express service between Liverpool and New York, has gone into commission, having made on her trial something better than 26 knots. Unlike the Lusitania and Mauretania she is not a subsidized vessel and will have to depend upon her superior and more numerous accommodations for the revenues to offset the loan made to her two sisters by the British government. There is but little question that she will be able to do so.

The principal dimensions of the Aquitania are:

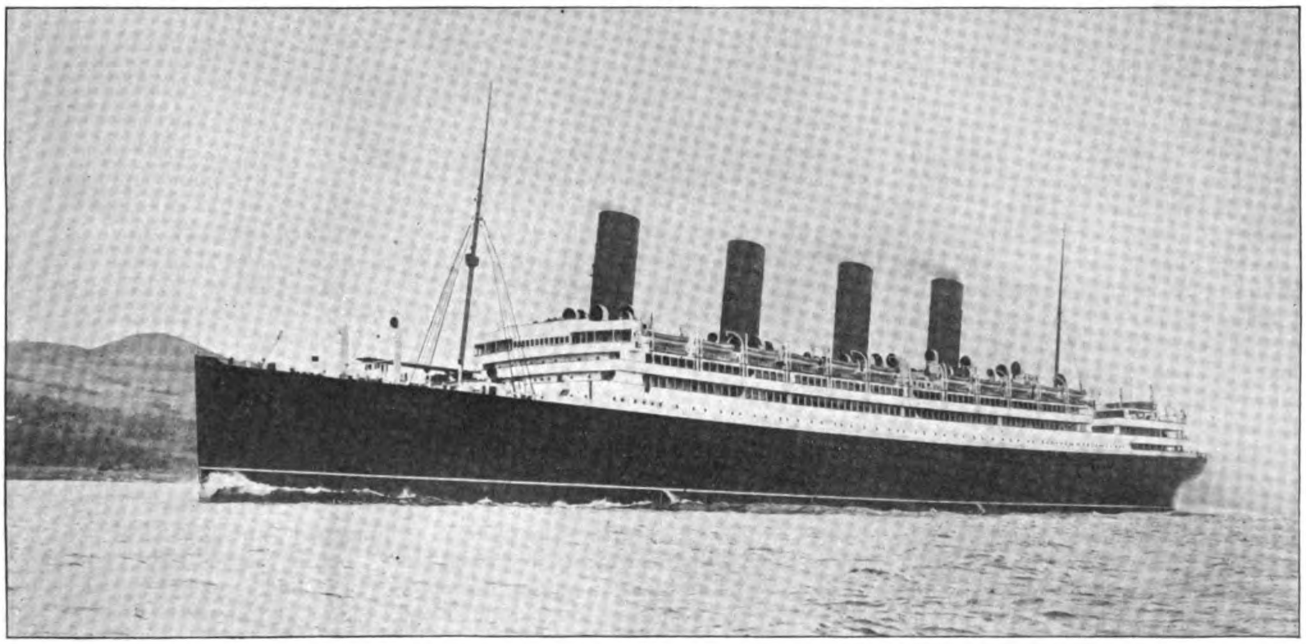
Length, 901 ft.

Breadth, 97 ft.

Depth to boat deck, 92 ft. 6 in.

Tonnage, 47,000.

From bow to stern there is a double bottom, which has a depth of 5 ft. 4 in., increased to 6 ft. 3 in. in the turbine room. The building up of the double bottom consists of longitudinal and transverse girders, some of them continuous to form water-tight compartments, and others having large man-holes to lighten the structure and to afford means of communication in the compartments which form ballast, reserve feed or condensed water tanks. In all there are 41 water-tight compartments in the double bottom, each of which can be pumped out or filled separately. Five of the fore and aft girders are solid or water-tight—the center girder, the



CUNARD LINER AQUITANIA

fifth girder from the center on each side—about 30 ft. from the center line —and the margin plates, from the last of which rise the side frames. There are further six longitudinal intercostal girders, composed of 12|20 in. plates, connected to the floor-plates and the outer and inner bottom by strong angles. Transverse to these longitudinals are the "floors" or girders, with manholes for communication between bottoms. The center girder is built up of 21|20 in. plates with double angles at top and bottom secured to a flat keel made of three plates of a collective thickness of 3½ in. The seven longitudinals on each side of this center girder are 12|20 in. thick, secured to the floor plates and to the inner (or tank-top plating) and outer skin by angles. There are the usual forward and aft peaks, which will serve as trimming tanks.

The Inner Propellers

At the after end, for a distance of about 70 ft. from the stern, the ship is cut away to give a clear run of water to the inner propellers. A strong heel casting is fitted to distribute the great stress which comes on the blocks at this part when the ship is being built. From this heel-post, there is a center girder supporting the propeller brackets and the rudder post. This girder, formed of double plates, is in continuation of the central keel and is of great depth—from the keel to the steering flat. On each side of this girder the boss-framing is attached by strong angles. This framing, it will be understood, is for carrying the propellers for the inner shafts only; those for the outer shafts are further forward, with the framing bossed in the ordinary way. To the aft end of the girder and keel plate is riveted the main casting of the stern frame to carry the rudder. Above the main casting of the stern frame there is a continuation of lighter structure which forms the outer line of the vessel aft. The inner starboard shaft brackets are connected to the main stern frame, and are hydraulically riveted to the stern frame.

The whole of the floors, intercostal girders and continuous girders, tank-top plating and outer bottom plating in the double bottom, and the whole of the stern structure have been riveted by hydraulic machines. The double bottom has been extended at its maximum depth to the turn of the bilge in order to accommodate the bed plate girders carrying the wing-turbines.

The side framing from the margin plate of the double bottom upwards is formed of steel channels. Web-frames, 36 in. deep, are introduced at every third frame throughout the greater part of the length of the ship, but closer where required, notably in the machinery space. All these extend at least to the deck 10 ft. above the load water line, and some to decks above this level.

The shell-plating is 23|20 in. thick amidships, the four sheer-strakes being doubled and riveted by hydraulic power. There are eight rows of rivets on the butt-straps.

Sub-Division of the Ship

The hull is divided into 84 compartments, in addition to the 41 in the double bottom. There are 16 transverse bulkheads, most of which extend up to 19 ft. above the load water line, the few others to 9 ft. above the load waterline. The turbine room is divided into three compartments by two longitudinal bulkheads, the machinery driving each wing shaft being isolated from the machinery driving the two inner shafts, which is in the central compartment. Similarly, the condensing plant is divided into two units by a centreline bulkhead. In order that the damage by collision at the point of junction of the transverse bulkhead in the machinery space with the shell plating should not affect two compartments within the skin of the ship a V-shaped connection has been made, so that damage at that point may be localized to one compartment only. The tunnel end of the condensing room is also divided up into several compartments by the fresh water tanks.

There is a fore-and-aft bulkhead on each side of the space occupied by boilers, a distance of 450 ft., so that in this part of the ship, where the compartments are largest, and where perhaps there might be the greatest danger due to the ingress of sea water, there is achieved the great desideratum of a "ship within a ship". The longitudinal bulkheads forming the inner walls of the bunkers are 18 ft. from the outer skin of the ship. The space within the inner walls, constituting the boiler rooms, is thus 60 ft. wide. In the coal bunker space again there are fitted partial transverse bulkheads dividing these bunkers into 10 water-tight cellular sections on each side, varying from 27 ft. to 33 ft. in length. These fore-and-aft bulkheads are connected to the shell by strong stays formed of double channels spaced 9 ft. apart.

The hatches to the cargo holds, too, are trunked and made water-tight to the weather deck. The engine and boiler casings are extra well stiffened by webs and made watertight to 20 ft. above the load water line. Thus water entering any of the cargo, engine or boiler compartments cannot flow into any adjacent compartment, but is confined within the trunk hatches or casings. This, in conjunction with the making of the decks water-tight, will localize the volume which may, owing to accident, be flooded with sea water.

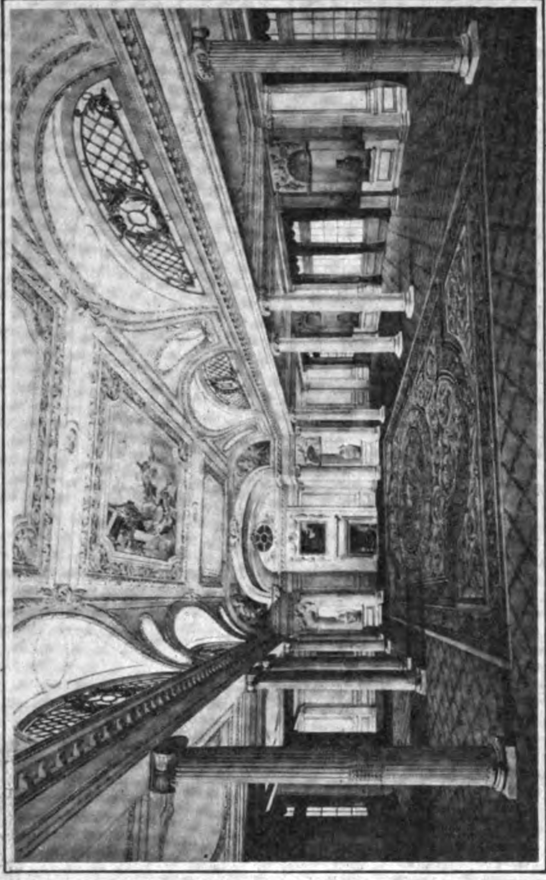
The main transverse bulkheads are formed of 12|20 in. plating stiffened by 12-in. channels spaced 2 ft. 6 in. apart, and at intervals there are introduced vertical web-stiffeners 3 ft. deep, formed of 10|20 in. plates and double angles. In line with the two intercostal girders between the web-frames at two points in the height of these vertical members, already mentioned, there are horizontal girders carried across the bulkheads at a level between the double bottom and "G" deck. It will thus be recognized that their construction is strong enough to resist any head of water due to one compartment being flooded while the other adjacent to it is empty.

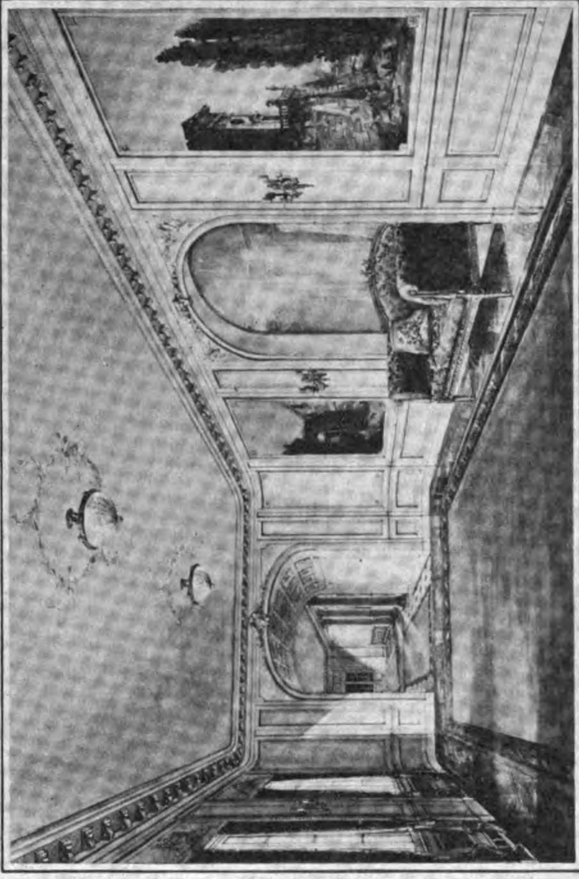
All the doors below and adjacent to the load line are of the sliding pattern, and are fitted with Stone-Lloyd quick-closing gear.

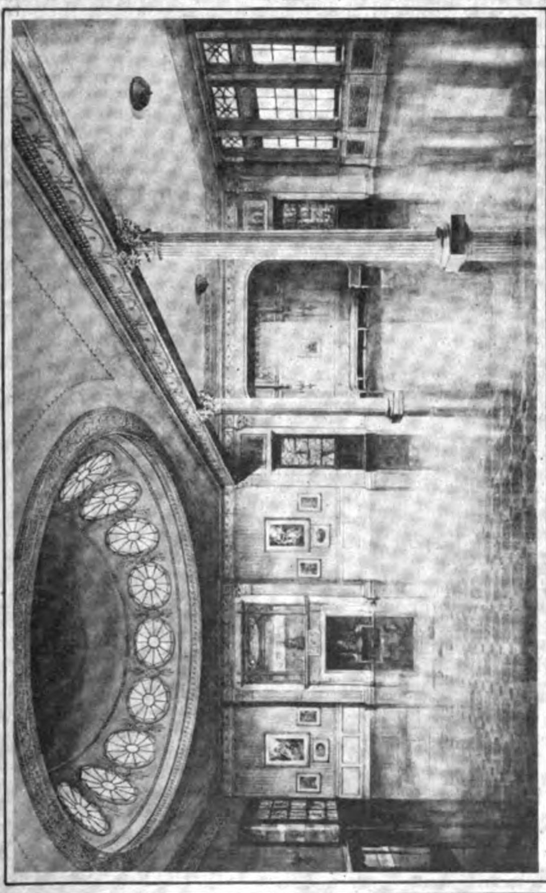
The anti-rolling tank takes the place of one of the coal bunkers on each side of the ship. A striking feature is the relatively small space required for the tank in which the water flows from side to side in order to counteract the rolling of the ship.

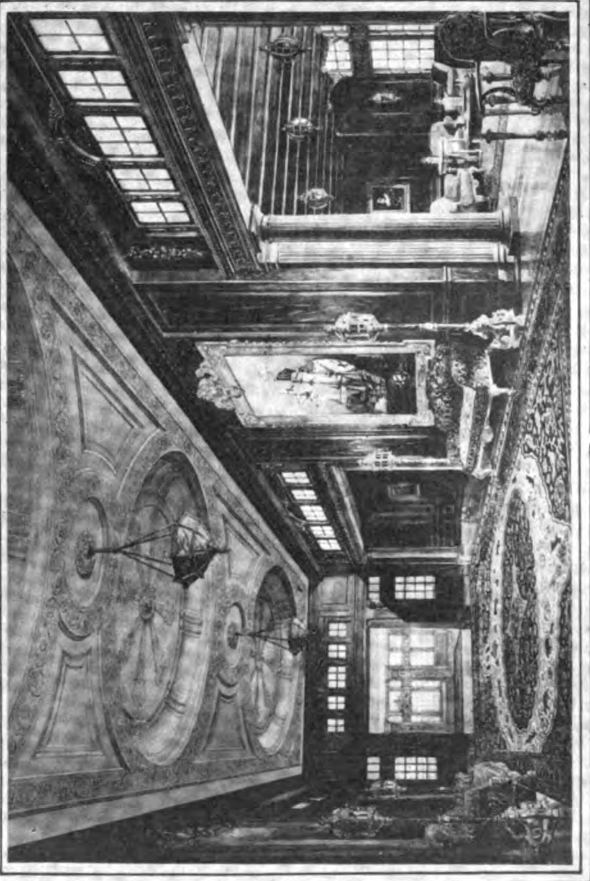
Construction of the Decks

Assuming the ship to be a box-girder formed by the double bottom and the side framing and shell plating, the top would be what is known as "B" deck, which is 73 ft. from the keel plate. The shell plating is doubled for a height of 12 ft. at the gunwale; for the remaining part of the girder "B" deck is single plated. Below this level there are five complete decks extending fore and aft, and distant apart vertically from 8 ft. to 11 ft., the greater height being on the dock where the first and second-class dining salons and some of the staterooms are located. At the ends of the ship before and abaft the machinery spaces there is a partial deck, making six within the molded structure of the ship. These decks have beams at every frame, consisting of 10-in. channels and these are completely covered with steel plating. The thickness of the deck-plating varies from ¾ in. to 1 in. Special beams are fitted in the turbine compartments in order to carry the gear for raising and lowering the upper part of the









FIRST CLASS DRAWING ROOM
FIRST CLASS SMOKING ROOM

CUNARD LINER AQUITANIA

FIRST CLASS LOUNGE
FIRST CLASS SALON

casing and the rotor. Girders also serve the function of transverse ties in view of the great width of the engine room casing.

Starting at the forward end of the ship we have No. 1 boiler room containing six boilers, No. 2 boiler room containing six boilers, then No. 3 boiler room containing six boilers, and finally No. 4 boiler room containing three boilers. Each of these boiler rooms is a watertight compartment within a watertight compartment. The fore-and-aft sides of the boiler rooms are formed by watertight steel bulkheads, which are some 18 ft. from the outer skin of the ship, and transverse steel bulkheads fitted with watertight doors, separate adjacent boiler rooms. We thus get watertight compartments on both sides of the ship outside the boiler rooms, whose floor levels, usually termed the "inner bottom" are also watertight, extending right across the ship, and situated several feet above the bottom of the ship. In these compartments coal is carried. Access from these to the boiler rooms is gained by watertight doors, fitted in the sides of the boiler rooms, and through these coal is conveyed to the boiler fires.

The transverse sides of the boiler rooms are formed of steel bulkheads and are also watertight, with watertight doors for communication purposes between various boiler rooms and the engine rooms.

Prevention Against Flooding

In the event of the outer sides being pierced, it is clear that flooding could only take place in the outer compartments or coal bunkers, formed by the skin of the ship, and the longitudinal bulkhead forming one side of any boiler room, the water-tight doors in this bulkhead preventing water from flooding into the boiler rooms. Similarly, if the bottom be pierced, water could only flood into the compartments formed by the bottom of the ship and the inner bottom, or watertight floor of the boiler rooms and the bunkers. So long as the floor remains intact, water could not flood the boiler rooms above. Further, the space between the aforesaid inner bottom and the bottom of the ship, is itself divided into watertight compartments by longitudinal steel divisions, so that if the bottom be pierced the space filled with water is thus limited in extent.

For such an event as flooding, consequent on collision, pumping arrangements have been provided for dealing with about 15,000 tons of water per hour.

Water ballast is carried in the cellular double bottom formed between inner and outer shells, and this space further provided large stowage capacity for the carriage of fresh and condensed water.

Boilers.

We can now take the various units in detail, commencing with the generating of steam in the boilers. There are 21 large double-ended boilers, each with eight furnaces, the combined area of fire grate being 3,542 sq. ft., while the most efficient parts of the internal surface, in contact with water outside and exposed to flame and hot gases inside, give an aggregate of 138,596 square feet, capable of converting 9,600 tons of water into steam per day.

The boilers are constructed for a working pressure of 195 lbs. per sq. in., and all work under forced draught. The air pressure is maintained by 28 fans 66 in. diameter, driven by 14 electric motors each 50 horsepower, one motor driving each pair of fans, which are arranged in separate fan rooms immediately above the boilers. The fans are connected to the boiler fronts by trunking, through which is discharged the air drawn in from the boiler rooms. The air is heated by coming in contact with tubes which in turn are heated by the waste gases, and is afterwards blown into the furnaces and through the burning coal.

Thus the air which passes down the huge ventilators on the top deck, first cools the firemen in the boiler rooms, ventilates the latter, and is finally drawn in by the forced-draft fans and utilized as described above for increasing the rate of combustion in the furnaces.

Each of the three forward groups of six boilers, with their corresponding uptakes and funnels, weighs 1,600 tons. There are four eliptical funnels, 24 ft. by 17 ft., and the distance from the top of the funnels to the level of the fire grate in the boiler room is some 160 feet.

Great care has been exercised in the design of the boiler room firing platform to insure that coal, ashes and dirt do not find their way to the innumerable pipes carried underneath, and the highest efficiency is thus assured, in the case of flooding, for the pumping arrangements, in providing immunity from choking of pipes.

Ash expellers.

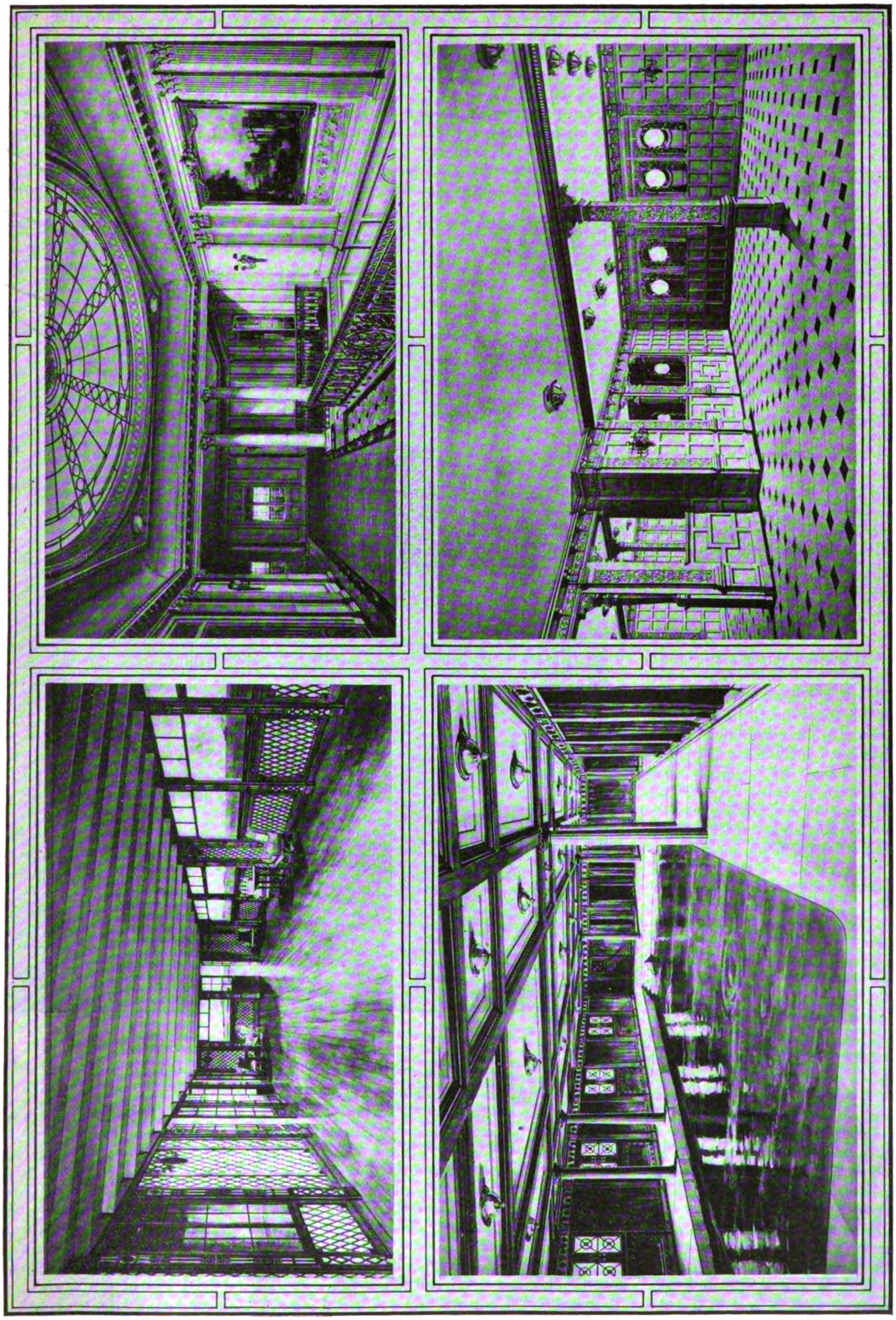
For disposing of ashes in the boiler rooms there are seven of the latest ash-expelling devices whose pumps are driven by steam turbines. The ashes are shoveled into a hopper, through gratings which regulate their size, and after being drawn into the expeller, are discharged through the ship's side far below the water line. These machines are fitted in large recesses in each boiler room, which serve for the stowage of ashes after cleaning fires, thus facilitating the work of the stokers by preserving a clear platform at all times. They may also be used as bilge pumps or discharging water overboard in case of emergency. In addition eight ash hoists are distributed through the boiler rooms. The plant will be called upon to dispose of about 1,200 tons of ashes during the round voyage.

On leaving No. 4 boiler room we pass through a watertight door and enter the center engine room, in which the low pressure ahead and astern turbines are situated; the high and intermediate pressure ahead and astern being located in the part and starboard wing engine rooms respecttively.

In all there are three engine rooms, one on each side of the center room, to which access is obtained by means of watertight doors in the longitudinal watertight bulkheads. All three compartments are watertight as in the case of the boiler rooms and bunkers.

Turbines

The turbines are directly coupled through our lines of shafting to the screws, this arrangement permitting a reasonable sub-division of the immense power, and they are arranged as already described in three engine rooms. An important departure from the Cunard company's previous practice has been made in this scheme. The triple compound system has been adopted for the turbines. In giving a greater range of expansion for the steam, this enables high economy to be maintained at normal speed, and by special adaptation of steam distribution, provides for the full use of reserve power necessary during a call for speed. By following the course of the steam this system may be readily appreciated. Thus, entering from the boiler rooms the steam first rotates the high pressure turbine in the port engine room; after expending work in passing through the blading, it is exhausted into the intermediate pressure turbine in the starboard engine room, the steam flowing then to a pipe large enough for a man to walk through, leading to both low pressure turbines, mounted on the inner shafts and housed in the center engine room. The low pressure turbines then exhaust to the condensers, where the steam comes in contact with some 18,700 tubes, having a cooling surface of 46,000



MAIN STAIRCASE
FIRST CLASS GRILL ROOM

CUNARD LINER AQUITANIA

GARDEN LOUNGE
FIRST CLASS SWIMMING POOL

square feet, through which the enormous quantity of 12,500 tons of sea water pass per hour, this being necessary for the condensation of the steam, and the efficient working of the turbines. It may be interesting to note in passing that if the condenser tubes were placed end to end they would reach a distance of nearly 50 miles.

In addition to the condensing plant already described, the machinery spaces contain a tremendous amount of additional apparatus required to act in an auxiliary capacity for the main propelling machinery due to working conditions in port; for all purposes in connection with the safety of the ship as regards rapidity and efficiency, dealing with collision, damage or fire outbreak, and also for maintaining the various services for the comfort and convenience of the passengers.

The steam pipe arrangement is such that in the event of any one turbine being disabled, the other three shafts can be worked, and since the turbine, as a machine, is eminently suitable for taking an overload, the fact of any single shaft being out of action would not appreciably reduce the speed of the ship.

Astern Turbines

A special feature is the large power which is provided for going astern, there being a separate turbine on each of the four shafts for this purpose. Here again economical use of steam has been insured by compound working. Thus the separate high pressure astern turbines, situated one in each wing engine room, exhaust into their respective low pressure turbines, these latter being incorporated in the same casing as the low pressure ahead turbines in the center engine room, one on each of the inner shafts. The total length of the engine space is 84 feet.

A further idea of the engine dimensions may be had by consideration of the weights. The high pressure ahead turbine is approximately 140 tons weight, the intermediate pressure turbine 150 tons weight, while each of the low pressure and astern turbines complete weighs 450 tons. The high pressure astern turbine weighs 120 tons.

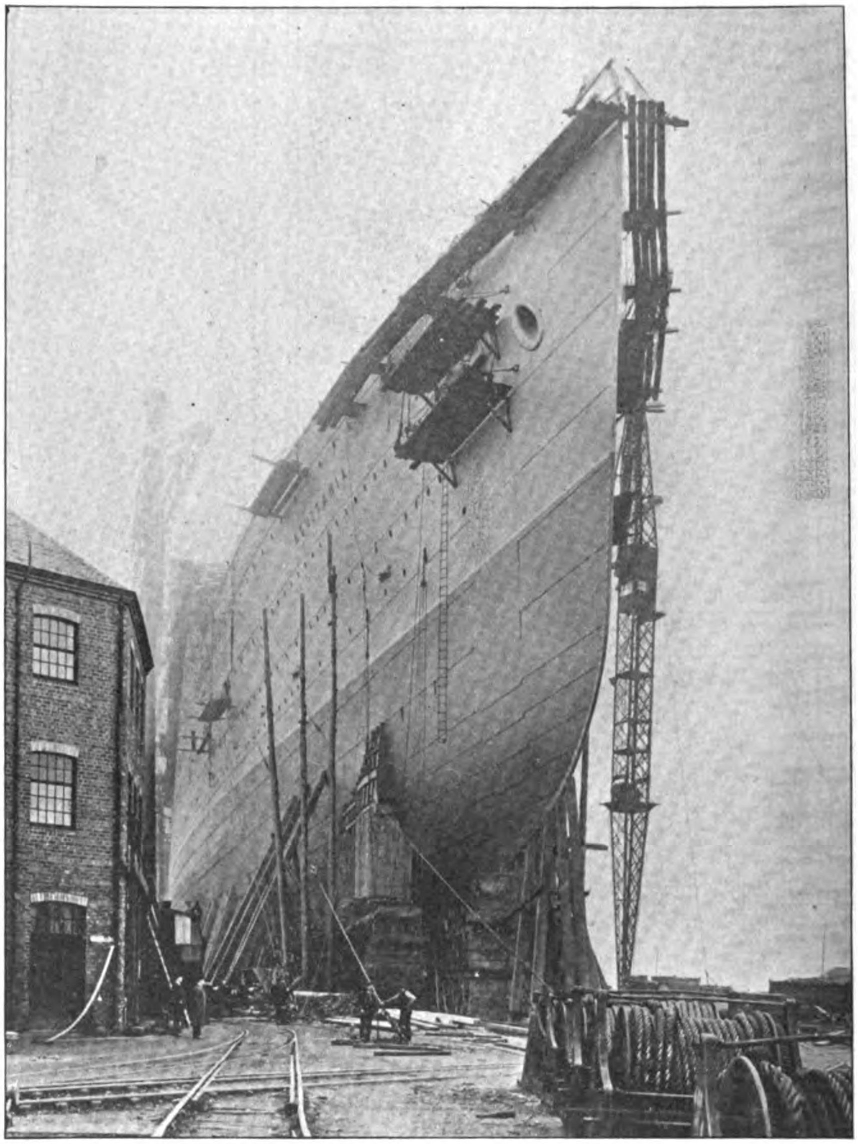
All the main turbines are of the Parsons reaction type, the steam passing alternately through wings of fixed and moving vanes. The moving blades are attached to the exterior of a drum and are interspaced between the rings of fixed blades, which are attached to the inside of a casing enclosing the drum. To this drum or rotor is coupled a line of shafting and propeller, which transmit the power for driving the vessel.

The total blades or vanes in the turbines amount to over 1,000,000 in number and range in height from 1½ in. to 20 in.

The problems in design to which the blading gave rise have been carefully considered, and the system and method of securing the blades, finally evolved after many costly experiments, is representative of much thought and study combined with practical experience gained from the running of the Lusitania, Mauretania and Carmania.

Owing to the enormous size of the turbines, their maneuvering valves, steam pipes and connections, the surfaces for heat radiation are such that the ventilating scheme had to be on a scale unparalleled in previous liners, and is the result of calculation and thoroughly scientific and practical experiment. Open type and other fans have been installed, the whole being capable of handling the enormous volume of 20,000,000 cu. ft. per hour.

The huge maneuvering and other steam valves are each operated by a combined steam and hydraulic reversing gear, which enables the engineer officer in charge to have full control of all engine rooms from the starting platform, by simply throwing over the necessary levers by hand.



BOW OF AQUITANIA, SHOWING HER EXTREMELY FINE LINES

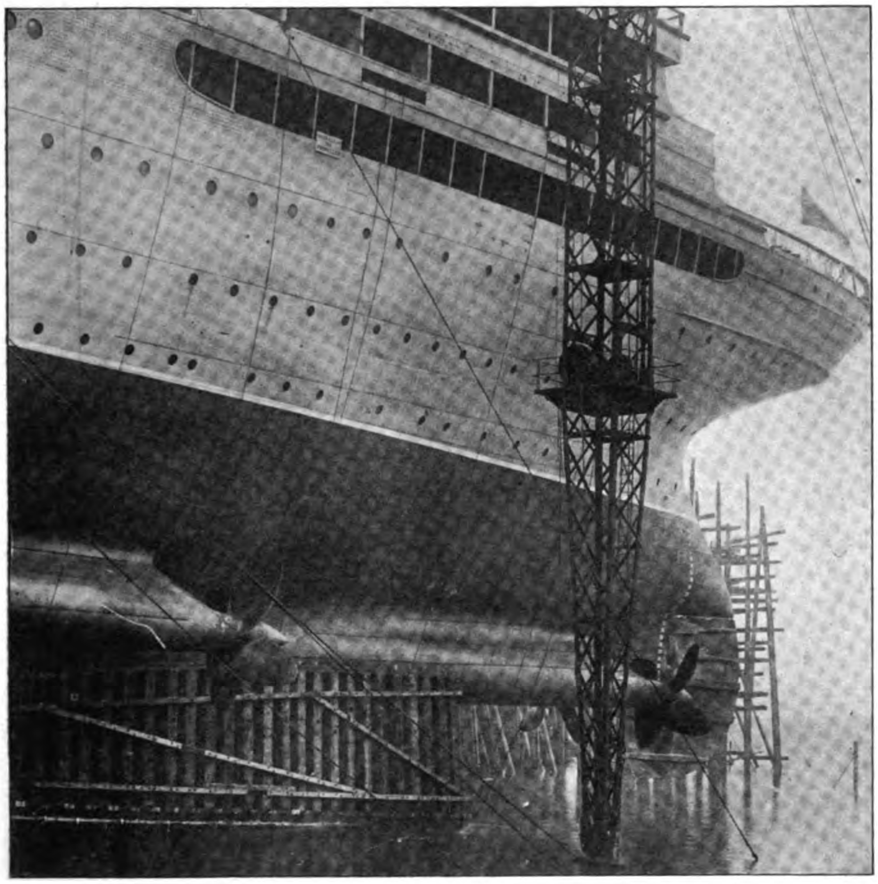
The starting platform is perhaps the most interesting feature of the engine room to the non-technical visitor, representing, as it were, the heart of the ship from which emanates the control of all energy and motive power, for the upkeep of this floating city, and for the health and comfort of all its inhabitants. It is situated at the forward end of the center engine room, and is partly enclosed at the after side by a screen. There

are over 120 indicators and gages arranged here, together with a barometer, indicating the atmospheric pressure, a clinometer showing the trim of the ship, and clocks, which are electrically controlled—the whole show the engineer officer in charge not only what is going on in the three engine rooms, but also in the most distant parts of the ship. Here also are found indicators for recording the speed of each turbine, together with instruments which show the direction of rotation at any moment, thus enabling the engineer officer to be certain that each turbine is responding to the controlling levers operated by him.

On the starting platform, on each side of the ship's center line, are situated the hand levers controlling the maneuvering valves. These maneuvering valves are of very large dimensions and an idea of their size may be had from a consideration of their weight, which is in the vicinity of 25 tons each. Their operation requires the provision of a separate small steam engine for each valve, these being brought into action by the controlling levers as easily as one would open or shut a water tap by hand. In case of emergency these valves can also be operated by hydraulic power from the starting platform.

The firing of the four boiler rooms is controlled from the starting platform, electric gongs being sounded in each boiler room, thus indicating at regular intervals when coal is required in the furnaces. Each boiler has eight furnaces, and in conjunction with the electric gongs already mentioned, numbers appear automatically on dials and the furnaces are fired in the rotation indicated.

Above the starting platform a model plan of the ship is outlined in polished metal, together with the longitudinal and transverse lines representing the water-tight bulkheads throughout the entire length. Corresponding to the position of the water-tight doors in these bulkheads, are fitted small colored electric lights, and by an ingenious electric contrivance these lamps immediately light when the doors in question are closed from the bridge, a similar indicator being also fitted there. The water-tight doors are shut from the bridge each day, and it is evident that should any door fail to act, the chief engineer is informed by the particular lamp representing the door, failing to light. He can thus at once take steps to have it closed.



STERN OF THE AQUITANIA, SHOWING HER PROPELLERS

The starting platform is in direct communication with the chief engineer's office, which is really a central bureau, being in direct communication with the bridge, steering gear, engine room, electric light engine room, doctor, purser, chief steward and other officers.

It is not, however, solely devoted to the propulsive control of the ship, but, in addition, most of the machinery and appliances required on board solely for the convenience and comfort of the passengers, can be controlled from its vicinity. As the modern liner has grown so also has the demand for machinery and appliances of all kinds, and this has added enormously to the responsibility of the chief engineer and his staff, which in the Aquitania number 34 engineer officers and 350 men.

Engineering Staff

In passing it will be interesting to note that the duties of about 30 per cent of the engineer officers are entirely confined to the care and operation of appliances, installed solely in connection with the passengers and their accommodation. For example, there is a ventilating engineer, who is responsible to the chief engineer for the air supply and temperature of all staterooms, public rooms, salons and passenger accommodation throughout the ship, speed of fans, opening of louvres, and the amount of heat supplied and regulated according to climatic conditions. Charts are placed before the chief engineer showing the temperature throughout the vessel every hour of the day.

The deck engineers are solely concerned with the supply of hot and cold salt water for the large swimming bath and morning baths, hot and cold fresh water in the state rooms and lavatories, evaporation of sea water by a large plant carried aboard capable of supplying 300 tons of pure fresh water per 24 hours, filtered and iced water for drinking and cooking, washing water for kitchens, pantries and sculleries, the provision of water for sanitary purposes, water for washing decks, and the regulation and supply of water for the fire service throughout the entire ship, also the hydraulic pumps for closing the watertight doors. The engine room is the center for the various services mentioned, and from there, in the vicinity of the starting platform, may be regulated the temperature and delivery of the services in question.

They are responsible for a large power oil engine and dynamo, "The Emergency Lighting Set", for use in

port and in case of collision, and for the supply of energy for transmission of wireless messages, navigating and various other lights throughout the vessel; also petrol engines for the motor life boats, together with the dynamo for wireless installation which is carried.

The temperature of ship's stores, which are carried in large compartments, have also to be regulated by powerful refrigerating machinery, capable of producing extreme cold, so that beef, mutton, game and poultry, bacon, fish, milk, fruit and vegetables, together with cold cupboards in the various pantries, and cabinets for cooling beer, wines and minerals, may each be maintained at the temperature found most suitable in each case.

General Electrical Plant

In addition to machinery in kitchens, noted elsewhere, electricity is used on the Aquitania for power purposes which the following will serve to illustrate, and careful examination is necessary during each voyage; passenger lifts, mail and baggage hoists, store lifts, service lifts, massage vibrator, and other miscellaneous apparatus in the gymnasium, the sterilizer in the dispensary, the fan for the laundry continuous drying machine, and about 200 electric motors throughout the ship; also for 10,000 fixed lamps, clusters and portables for the ship's lighting, 70 side lanterns, Admiralty Morse lamps, masts, side lights and stern lamps, with indicators for same; 20 fire alarms, 27 intercommunication telephones, 11 loud-speaking telephones for use in engine room, deck or bridge, or any place where noise has to be overcome; 36 electric clocks, 1,440 electric bell pushes, life boat lamps, the complete Marconi installation, the electric control of steam whistles, etc.

The above may serve to give a general idea of the different electrical appliances which come under the care of the electrical engineer officers and require careful attention during each voyage.

The machinery necessary for warping the vessel in and out must be very powerful in the case of a vessel like the Aquitania, and this is dealt with under the heading of "Navigation Appliances".

Two engineer officers relieve each other, with six-hour watches throughout the whole voyage, in the steering gear engine room, wherein is situated the massive steering engine operating the ship's rudder, and their sole duty is to see that the machine works smoothly.

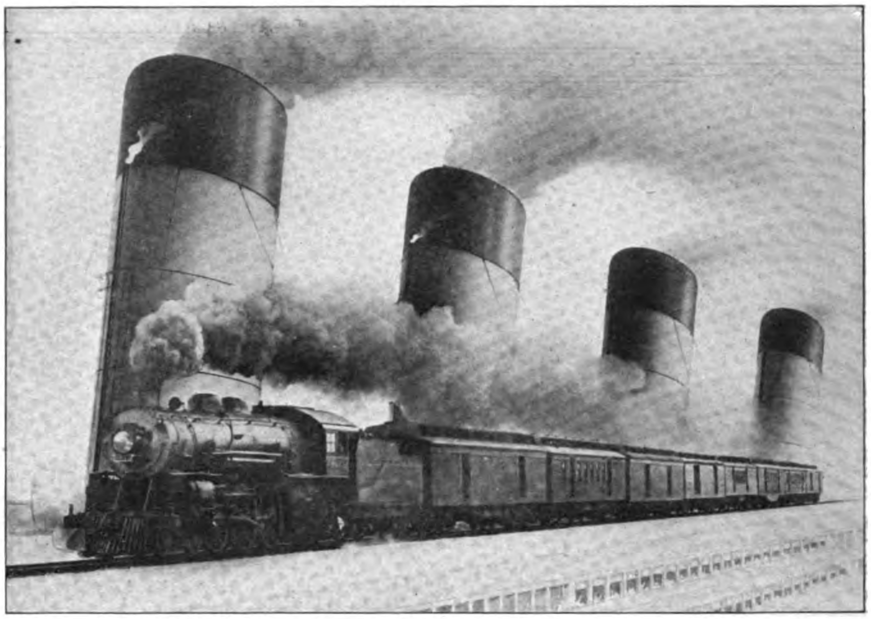
A thoroughly equipped engineering workshop, with tools operated by electric motors, is provided on board for the quick repair, by the engineering staff, of any unit which might go out of order.

Driving fans in cabins and crew's quarters, radiators for heating rooms, electric tell-tale on bridge from engine room, deck cranes for baggage, watertight door indicator, submarine signaling apparatus, iceberg detecting apparatus, searchlight, heaving ship's lead, shore coaling winches, electric clocks synchronizing with master clock, boot cleaning, knife cleaners, ice cream machine.

The refrigerating machine is entirely in connection with the cuisine department, as no refrigerated cargo is carried. The machinery consists of a powerful compound duplex machine working on the carbonic anhyride system with two compressors, two independent evaporators, duplex pumps for circulating cold brine through the various chambers, and pump for circulating sea water through gas condensers.

Briefly, the action of the machine is as follows: A steam engine provides power for compressing the gas in the compressor, the temperature of the gas is thus raised, but the heat is dissipated immediately afterwards by the action of the cooling water circulated through the condenser, the gas being liquified and its temperature considerably reduced as a consequence. It is then passed through the evaporator, where it extracts heat necessary for evaporation from the brine, cooling this latter to a very low temperature. A separate pump circulates this cold brine throughout the various chambers, the air in which is, of course, cooled by contact with the brine piping. On leaving the evaporator, the carbonic acid gas is drawn into the compressor, the cycle of operations being then continuously repeated.

A vital safeguard is provided, in that the 45 principal bulkhead doors are fitted with the Stone-Lloyd hydraulic system. The doors can be kept closed by the officer on the bridge for as long as he considers advisable, yet they can, when required, be opened locally by anyone desirous of passing through, but the doors close immediately; the manual effort is withdrawn; they cannot be left open. Thus is fulfilled the recommendation of the International Conference on Safety of Life at Sea, that all watertight doors shall be kept closed during navigation except when necessarily opened for the working of the ship.



THE AQUITANIA COMPARED WITH THE TWENTIETH CENTURY LIMITED. THE TWENTIETH CENTURY LIMITED IS 576 FT. LONG WHILE THE DISTANCE FROM THE FIRST TO THE LAST STACK OF THE AQUITANIA IS 668 FT.

The auxiliary condensing plant is in duplicate, one set being placed in each wing engine room, and consisting of condenser, air pump and circulating pump, and is reserved almost entirely for condensing the exhaust steam from engine room and deck auxiliaries, while working in port. Suitable cross connections are fitted whereby this plant may be used to relieve the auxiliary exhaust system at sea.

There are four water service pumps (two in each wing engine room), one sanitary and one wash deck pump in the center engine room. In the port wing engine room there is a motor-driven sanitary pump, a departure from ordinary practice, the re-

sults of which will be followed with interest. For operating the Stone-Lloyd doors, three pumps of strong construction are situated in the center turbine room. There are four bilge pumps, one in each wing engine room, one in the main condenser room, and one in the pump recess fitted in the cross bunker between Nos. 1 and 2 boiler rooms.

For supplying hot salt water to baths a pump is provided in the port condenser room. Two pumps for supplying drinking and cooking water, and washing water respectively are fitted in the port wing engine room, these pumps being connected with alleyways thermo tanks are fitted.

Electrically-driven fans draw in cold air which is warmed by contact with steam-heated tubes, and then discharged through trunking to different parts of the ship. By reversing the action of the fan, vitiated air may be exhausted in warm weather. In addition, and when steam heating is in use, 50 fans will supply cold air or exhaust foul air into the open.

In all, the plant is capable of handling 12,000,000 cu. ft. per hour.

The system is arranged on the flow and return low pressure principle of sufficient capacity to enable a temperature of 70 deg. Fahr. to be main-

ONE OF THE AQUITANIA'S POWER LIFEBOATS EQUIPPED WITH WIRELESS

the water storage tanks in the ship's double bottom, and arranged to discharge to service tanks on deck, whence the supply to the various draw-off taps is led by gravitation.

The cargo machinery consists of six cargo and warping winches of the silent type. For dealing with passengers' baggage two 30-cwt. electric cranes are fitted having a 21 ft. 6 in. radius, lifting from a depth of over 80 ft. at a speed of 120 ft. a minute to 300 ft. per minute.

Each compartment of the vessel and the accommodation throughout has received separate consideration. For supplying warm air to cabins and

tained in all rooms and corridors, in all conditions of weather experienced in North Atlantic, even when obtaining 18 deg. of frost or 14 deg. Fahr.

Safety and economy are insured by the adoption of a steam pressure of 5 lb. or under. It may be mentioned that all radiators are fitted with patent thermostatic valves by means of which the temperature may be regulated to within 1 deg. Fahr.

Constant circulation is effected by means of a special pump, capable of maintaining 15 inches of vacuum, which is connected up to the return pipes.

The hot salt or "Roman" type of bath is perhaps the most popular of all on board ship. This is evidenced by the very large demand made upon the system, and in the Aquitania the installation especially reserved for this purpose is worthy of note. Water is first pumped to a storage head tank on the boat deck. Situated in the condenser room is a special storage pattern calorifier, taking cold salt water at the inlet from the head tank; steam heating tubes within the casing raise the temperature of the water to 160 deg. Fahr., when an automatic device comes into action and cuts off the steam supply. A special pump is used for inducing primary circulation throughout the system.

Supply pipes are led to various points throughout the ship for sanitary service, washing decks, baths and fire service. Two powerful duplex pumps and one motor-driven pump situated in the main engine rooms are connected to ship's side valves and lift sea water up into tanks of large capacity on the boat deck, thus by gravitation insuring a steady flow and plentiful supply in the supply mains. The total capacity of the plant is 520 tons per hour. A large size main completely encircles the main deck, from which rising mains and downcomers supply the remaining decks.

Fire Service

The fire service is particularly ample. It has been arranged that the above-mentioned pumps may discharge direct to the fire main should occasion arise, without passing through the head tank. In addition, the ballast pumps are connected up suitably for doing fire duty in emergency, while there are five hand pumps, three of which are fixed on the shelter deck and two are of the portable type.

An important feature of the Aquitania is the salt water plunge bath equipment; the pumping arrangements permit of frequent or continuous changing of the water and the maintaining of better conditions than those which obtain in plunge baths ashore.

The hot washing water or "hot condensed" service performs a most extensive duty, branches from circulating mains being led to no less than 850 draw-off taps. These are situated in all lavatories throughout the vessel, and connect with basins in first-class private bath rooms and staterooms, dispensary, operating room, barbers' shops, service lockers and sinks in kitchens, pantries and sculleries.

Two storage pattern steam-heated calorifiers, each of a storage capacity of 200 gallons, are fitted, and the

working output is rated at 2,500 gallons per hour.

Water is pumped from one of the double-bottom tanks to a head tank on deck and thence by a downcomer is led into the calorifier, where its temperature is raised to 160 deg. Fahr. and automatically regulated. Primary circulating is induced by means of separate pumps and the mains are so arrange that no tap is further distant than 4 ft. from its supply main.

Or cold washing water is led to wash basins of first, second and third class, officers', engineers', crew's and hospital lavatories, to basins in first class private bath rooms, to basins in first and second class staterooms, dispensary, operating room and barbers' shop, to service lockers, sinks in galleys, pantries, sculleries and photographic dark room. The condensed water pump draws water from certain of the double-bottom tanks, discharging to three separate head tanks on deck whence gravitation supply is led to the various draw-off taps. The pump has a rated capacity of 50 tons per hour.

Drinking Water

Special provision is being made in this service to insure an ample supply of pure fresh water. In addition to the ordinary filtering devices for the arresting of suspended matter and removing of any discoloration, the water will be passed through special germproof media.

Sterilizing arrangements are provided for the periodical overhaul of the filtering media. This applies equally to all portable water used. The water for drinking and cooking purposes is stored in special double-bottom tanks having a separate pump and head tanks to enable sudden and large demands to be adequately met. The drinking water is passed through a cooler, which is part of the refrigerator installation, prior to reaching the various taps.

It is difficult to realize the important and extensive application of electricity on board such a vessel as the Aquitania. In order that it may be understood, it will be as well to furnish at some length particulars of the various uses to which current is put.

There are nearly 10,000 lights in the ship and 200 electric motors.

The generating plant consists of four 400-kilowatt turbo-generator sets by the British Westinghouse Co., and the design embodies many special features. Among others may be mentioned the system of securing the turbine blades, these being of the impulse type, of steel and cut from the solid, while the dynamo commutator is of the radial type. The plant has an output the equivalent of that necessary for lighting a town of 110,000 inhabitants. The electric energy is distributed on the three-wire system, having 220 volts between the outers, and 110 volts between each out and the middle wire. All the large motors are wound for 220 volts and are connected across the outers, while the smaller kitchen motors and all the lighting motors are arranged for 110 volts and are connected between the outers and the middle wire.

The 14 large motors which drive the 28 forced-draft fans for the boilers, and the motor-driven sanitary pump are mentioned elsewhere. In addition to these the engine room equipment proper includes motors for the engine turning gears and lifting gears, motors for operating the large sluice valves, and motors for driving the engine room and fan room ventilating fans, as also all machinery in the engineers' workshop. Electro-mechanical revolution indicators are fitted at the starting platform.

There are nine decks in the Aquitania, in addition to the hold, but one (the lower orlop) is only partial, being ahead and abaft the machinery. Of these decks six are in the molded structure of the ship. Above these there are three superstructure decks, the first extending for about 640 ft., the second for 624 ft., and the third, or boat deck, for about 464 ft. in length amidships, further aft, a deck-house for the second-class quarters is utilized for the carrying of additional boats on the same level as the boat-deck proper. The total height from the keel to the boat-deck level is 94 ft.

On the boat-deck accommodation is to be found at the forward end for the officers' quarters and mess-room, and at the after end for men servants' mess room, as well as for the Marconi wireless telegraph office. The deck-house covers the skylights or the domes from the important public rooms on the deck below. The ceilings of these public rooms are at a much greater height than is usually the case, a special arrangement of structural work being introduced to give vertical strength, while the coamings are particularly heavy to make up for the larger openings in the decks.

On the next deck, designated the "A" deck, the principal apartments arranged for are the first-class drawing-room, lounge, salons, smoking room amidships, and a second-class lounge further aft. The first-class lounge and smoking room are connected by the long gallery. On either side of the first-class lounge is the garden lounge.

On the "B" deck there are arranged many special staterooms with one and two beds in each. The promenade extends all around the deck-house, but is screened on each side at the forward end for a considerable length by extending the bulwarks up to the "A" deck, and fitting large sliding windows. In this way is formed a sheltered promenade. On the after end of the "B" deck there is the second-class smoking room and drawing room, and the verandah cafe, outside of which there is extensive promenading space, and above which is a boat deck.

The "C" deck, which forms the top of the molded structure of the ship, and is 66 ft. from the keel, is almost entirely given over to sleeping quarters. At the forward end of this deck there is space for windlasses, capstans, cargo hatches and cargo winches, and a house enclosing the entrance to the third-class quarters on the decks below. The forward part of the deck affords a promenade for the third-class passengers in fine weather. At the after end of the ship, also, there is space for working the ship with the necessary winches, capstans and gear.

The Cuisine Department

The first deck within the molded structure, designated the "D" deck, is given over largely to the cuisine department. In order to add to the comfort and simplify ventilation, the height between this and the deck above is 11 ft. The first-class dining salon is almost amidships and of great length and the full width of the ship. A foyer, or reception room for the first-class passengers forward of the first-class dining salon occupies a considerable space. The second-class dining salon is further aft, and is also of great dimensions. Between the two is the kitchen and all that appertains to the culinary arts. The second cabin gymnasium is also on this deck. At the extreme after end of this deck there is a third-class smoking room and entrance to the third-class quarters, while at the forward end there is a large third-class social hall.

The "E" deck is regarded as the "working deck of the ship", and thus there is upon it accommodation for stores and other departments. The first-class swimming bath and gymnasium are situated on this deck. There are, at the after end of this deck, state rooms for second-class passenger accommodation. Large spaces are allotted for third-class

promenades. There is a passage extending right fore and aft for the use of third-class passengers. One large compartment is given over for the handling of mails and of passengers' luggage during the voyage. Gangway doors through the shell plating of the ship on each side give entrance to this deck. There are smaller doors affording entrance to each boiler room. Isolated on this deck are hospitals, and third-class kitchens.

On "F" deck there are large dining salons for the accommodation of third-class passengers, the kitchen being on the deck above.

The next deck, "G", is reserved entirely for third-class passengers.

The seamen, firemen and trimmers are accommodated at the extreme bow of the ship on several decks, while the stewards have their sleeping quarters at the extreme after ends of the various levels. Under "G" deck, forward and aft of the machinery space, is a hold or partial deck for cargo, baggage and mails, while at the extreme after end of the ship is steering gear immediately in contact with the rudder head.

Officers' Quarters

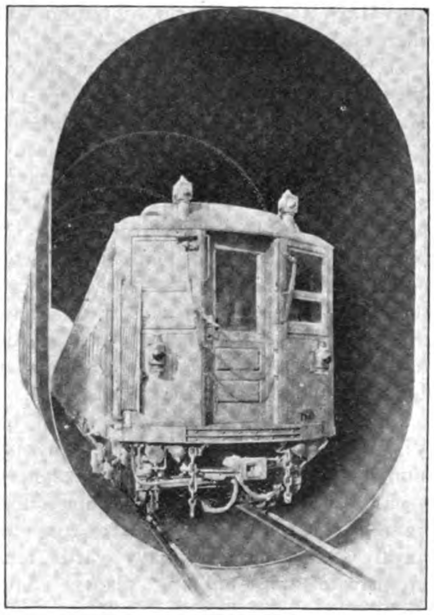
As in the Mauretania and Lusitania, the bridge and officers quarters are adjacent, but are on a larger and more commodious scale. Each officer has a room to himself, besides which there is a large smoking room and the usual bath rooms, oilskin lockers and other accommodation.

The chart room is in close proximity to the bridge, and is fitted with every aid to navigation and the ship's safety that human ingenuity can provide. Amongst other instruments which are here installed may be mentioned the "Ralston Metacentric Board", by which the stability of the vessel can be computed and checked at any instant of the voyage, and her center of gravity so arranged as to give the greatest possible safety, and at the same time comfort to her seaworthiness.

On the bridge itself everything is completely up to date, and here are fitted every appliance which can in any way assist or facilitate duties of the captain and officers in the safe navigation of the vessel.

By means of an indicator the officer in charge can at any time see at a glance the position of any or all the watertight doors—whether they are opened or closed. A feature of the installation fitted on the Aquitania is, that there are two control dials on the bridge instead of one. One control governs the doors in the longitudinal bulkheads, the other the doors in the transverse bulkheads. The object of this is to enable the commander to maintain the doors along the inner skin of the ship in the closed position, and yet to be able to temporarily place the doors in the transverse bulkheads in the open position to facilitate the passage of material for the efficient working of the vessel at such times as circumstances render necessary.

Loud-speaking telephones, similar to those in use in the navy, admit of instant verbal communication with the engine rooms, crow's nest, stem head, after docking bridge, steering engine flat, after wheel house and other parts of the vessel. There is telephone communication between the bridge and all the principal offices of the ship, also to the Marconi house, in which there will be an operator on watch constantly day and night.



A NEW YORK SUBWAY TRAIN IN ONE OF AQUITANIA'S FUNNELS

The engine room telegraphs are of naval pattern, and are of the positive gear dead-beat type. There are also engine movement indicators, revolution indicators, and various docking and anchoring telegraphs.

As in all the company's passenger vessels, the Aquitania is fitted with the submarine signal apparatus—the receiving instruments of which are installed in a special sound-proof cabin situated in the bridge house.

All the navigation lights are doubly wired and are fitted with alarm indicators, which automatically give warning of any fault and switch on the auxiliary set.

With regard to fire appliances—electric fire alarms communicate from various places direct with the bridge.

All the cargo holds, mail rooms, baggage rooms and other parts of the ship are connected with the bridge by a combined system of indicator and extinguisher.

The ship is wired for searchlights, and besides being fitted with a long-distance wireless installation, is also fitted with lamps for Morse signaling.

The main steering gear is arranged well below the water line, and there is in addition a powerful auxiliary gear fitted on a flat below this, and connected to it. Both are worked by the latest system of hydraulic transmission, known as the telemotor, which may be operated from three different stations; the navigating bridge forward, the navigating bridge aft, and the steering gear compartment itself.

The ship is equipped with five of the latest pattern Kelvin, Bottomley and Baird compasses, the cards of which are of a new design specially prepared for the Aquitania.

There are two latest type electrically-driven sounding machines for taking deep-sea soundings whilst proceeding at full speed.

It is scarcely necessary to say that the machinery necessary for warping the vessel in dock must be very powerful in the case of the Aquitania. For this purpose there are four large steam capstans forward and four aft, all actuated by engines situated on the deck immediately below them. Two large windlass heads are located forward for heaving in the 11-ton anchors by means of cable 3⅞ in. in diameter. There are besides the anchor windlasses, two windlass heads on deck for mooring cable. Cable holder brakes are able to hold a load of 250 tons when riding at anchor. All four capstans used simultaneously would give a hauling power of 1,050 horses.

On the foremast are two huge derricks over 70 ft. in length, to facilitate the loading and discharging of cargo and baggage.

The ship has 28 pairs of davits, consisting of both the swan neck type and the Welin type, whilst amongst her boats are two motor lifeboats fitted with wireless telegraphy.

Lifeboats and Motor Boats

In addition to, and quite independent of the lifeboat equipment of the Aquitania, there are two large motor boats fitted with wireless telegraphy. These motor boats, constructed by Thornycroft, are carried on the boat deck, one on the port side and the other on the starboard side. Each boat is 30 ft. in length by 9 ft. 6 in. in breadth.

The design shows a decided depar-

ture from any previously accepted form of ship's lifeboat. The motor boat's primary function is to tow the ordinary rowing lifeboats. It is fitted with wireless telegraphy apparatus, having a range of about 100 to 150 miles for transmitting. It would consequently be able to keep in constant communication with steamers in case of emergency.

There is ample space for the stowage of blankets, medical store and other necessaries. The engine is well protected by a closed compartment, and would consequently not be affected by heavy seas, wind or rain.

Generally speaking, the design is one of the best and most practical proposals to meet the difficulties experienced at sea.

The boats are fitted with a Thornycroft four-cylinder motor of 30 B. H. P., fitted with reverse, this motor complying in all respects with the suggestion of the boats and davits committee, in other words, starting on petrol, running on paraffine.

Forward of the motor space a sound-proof room is fitted for the wireless operator. There is a short deck at each end, and a wide gangway fore and aft.

Also both forward and aft, a watertight well is arranged, fitted with seats and lockers.

There will be 80 large lifeboats stowed on the Aquitania decks. Ample accommodation is provided in the boats for all people on board the ship. The latest and most up-to-date appliances for placing them in the water has been adopted.

It is difficult to convey an adequate idea of the immensity of the machinery in the Aquitania, but some impression of this will, perhaps, be best gained by consideration of the general lay-out and space occupied as a whole.

The greater part of the vessel's length is taken up with propelling machinery, engines, boilers and auxiliary machinery, and this, for the full breadth throughout if we include the side bunkers. It should also be borne in mind that the height, from platform level to the top of the engine room skylight, is 92 ft.

The Polson Iron Works, Ltd., Toronto, launched on Saturday, May 30, two lighters for the Department of Railways and Canals, Dominion government, to be used at Port Nelson, Hudson bay. The lighters are 128 ft. long, 21½ ft. wide and 10 ft. deep, and will steam to Port Nelson under their own power, carrying cargo to the new port.

Naval Extravagance

It is very gratifying to note that some one has at last awakened in congress to the extravagance of the Navy Department. THE REVIEW has time and time again pointed out the utterly ridiculous sums of money which the Navy Department requires to build its vessels in navy yards and to repair them after they are built.

In the April issue attention was called to the striking differences between the cost of the collier Jupiter, built at the Mare Island Navy Yards, and the Proteus and Nereus, built at Newport News. The sum of $1,000,000 was appropriated to build each of these colliers. The Newport News bid for the Proteus and Nereus was $990,000 each but the Mare Island Navy yard found it impossible to build the Jupiter for $1,000,000 and the appropriation was increased to $1,200,000.

It must be borne in mind that out of this sum the Navy Department does not have to allow anything for overhead, such as interest on investment, insurance, taxes, depreciation, maintenance and upkeep, which in any private enterprise will run anywhere from 15 to 25 per cent of sales. The bid of the Newport News company is therefore all the more remarkable and shows how utterly impossible it is for navy yards to compete with a private yard in a commercial sense of the word.

Now comes William A. Jones of Virginia, who enlivened the discussion in congress on the naval appropriation bill with some very interesting figures regarding the relative cost of naval vessels built in navy yards and in private ship building plants. The figures are authoritative, as they come either from the Secretary of the Navy or the Chief of the Bureau of Construction and Repair, and include besides the first cost of the vessels a record of the cost of repairs on the ships since they have been in service.

Taking the case of the battleship Connecticut, which was built eight years ago in the New York navy yard, it was shown that the Connecticut cost $374,000.00 more than a sister ship, the Louisiana, built by contract at the yards of the Newport News Shipbuilding & Dry Dock Co., Newport News, Va., the cost of repairs on the Connecticut up to March 1, 1914, amounting to $31,000 more than the cost of repairs on the Louisiana up to the same date. Again, in the case of the Florida, which was also built at the New York navy yard, the first cost of the ship was $2,269,000 more than that of the Utah, a sister ship, built by contract at the New York Shipbuilding Co., Camden, N. J. The cost of repairs on the Florida up to March 1, 1914, amounted to $55,000 more than the cost of repairs on the Utah.

Still another example for comparison was offered by the completion this year of the battleships New York and Texas. The New York was built in the New York navy yard and cost $1,463,000 more than the Texas, a sister ship built by the Newport News Shipbuilding & Dry Dock Co., Newport News, Va. Notwithstanding that the total expenditures on the battleship New York up to March 1, 1914, indicate savings of $413,750.50 for the construction of the hull and $245,884.91 for the construction of the machinery as compared with the original estimates for the ship, and that additional amounts above the contract price of the Texas were paid by the government for extra work on the Texas, nevertheless the government-built ship New York cost the government more than a million dollars more than the contract-built ship Texas.

At present the navy department is requesting an appropriation for the construction of two battleships, eight destoyers and three submarines, the cost of which, exclusive of armor and armament, according to estimates of the navy department, would be, if built in private yards, about $25,600,000, while if the ships were built in navy yards the cost would be about $32,003,000, or about 28 per cent more than the cost under private contract.

The significance of these figures led Mr. Jones to oppose very strongly the policy of the government in placing large contracts for the construction of naval vessels with navy yards, only two of which are at present equipped for building large ships, whereas there are now in the United States no less than five large private shipyards which have been developed in recent years very largely for the purpose of undertaking such work, and which have amply proved their ability to turn out the high grade of work demanded by the navy department under the most rigid inspection at a much less cost than is possible in navy yards.

The Gas Engine & Power Co. and Charles L. Seabury & Co., Cons., Morris Heights, New York, recently launched the cruiser Flier for the estate of the late M. C. D. Borden, to take the place of his steam yacht Sovereign. The Flier is 66 ft. long, 10½ ft. beam and 3¼ ft. draft, and is equipped with two Speedway motors of 200 H. P. each, which will give her a guaranteed speed of 25 miles an hour. She will be used between New York and Red Bank, where her owner has a summer home.

Oil Carrier Sebastian

The First Vessel Built in Scotland
Having Two-Cycle Diesel Oil Engines

THE oil-carrying vessel Sebastian, which has been built by the well known Caledon Shipbuilding & Engineering Co., Ltd., of Dundee, for the Sebastian Diesel Motor Boat Co., Ltd. (Messrs. Lane and Macandrew, managing owners), of London, is the first oil-tank vessel constructed in Scotland to have two-cycle Diesel oil engines.

The general design of the ship, as shown in Fig. 1, is very similar to other bulk oil-carrying vessels, except that two pump rooms are fitted. The following are the leading particulars of the ship: Length B. P., 310 ft.; breadth, molded, 45 ft.; depth molded to upper deck, 26 ft. 3 in.; height of 'tween decks, 7 ft. 6 in.; load draught, 22 ft. 1 in.; deadweight on above draught, about 4,600 tons.

The vessel has been constructed with ordinary transverse framing and to the highest class of Lloyds Register and under their special survey, the scantlings and construction in way of the oil tanks, the machinery space and forward hold being shown in Figs. 1, 3 and 4. The vessel also conforms to the regulations of the Suez canal for the carriage of petroleum in bulk.

There are six main oil tanks, separated by pump rooms into three pairs, so that three kinds of oil may be carried without fear of contamination, and a cofferdam is fitted at each end of the oil tanks to isolate the oil cargo from the other parts of the vessel. The center longitudinal division in the

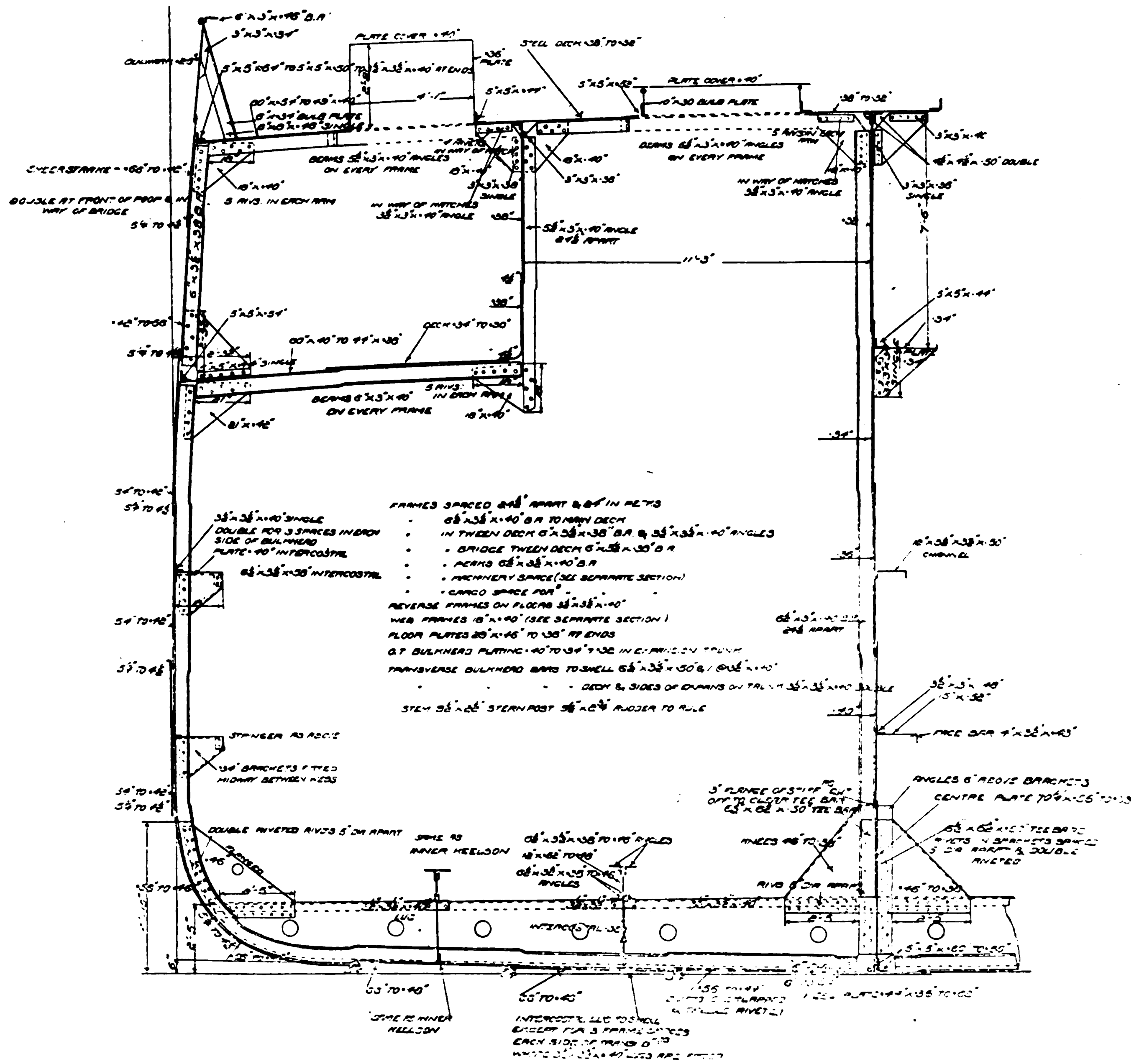


FIG. 2—MIDSHIP SECTION OF THE SEBASTIAN

main tanks and in the main fuel tank is oil-tight to the upper deck. At the side of the expansion trunk summer tanks are formed over each main tank, and each summer tank is provided with a hatch containing 3 per cent of the total capacity of the space to allow for expansion of the oil. Great care has been exercised with the boundaries of both the transverse and longitudinal bulkheads to ensure perfect oil-tightness, and double bars have been fitted, one 3½ in. by 3½ in. and one 6½ in. by 3½ in.

Ample capacity is provided for oil fuel in a cross bunker immediately forward of the engine room and in a large, deep tank under the forward hold. The double bottom under the engines is arranged for fresh water, while the peaks are arranged as ballast tanks.

An efficient installation of oil piping capable of rapidly discharging the whole cargo has been fitted, consisting of a double 8-in. pipe line with a suction valve to each tank and master valves at each transverse bulkhead, and with cross-over connections and valve between each pair of tanks. All tank valves are operated from the upper deck, and there is also a connection from the 8-in. line to the cofferdams for filling and emptying these spaces. On the upper deck the pipes are so arranged that two kinds of oil can be discharged over each side at the same time, and these pipes can also be utilized for filling the oil tanks. There is also a discharge over the stern, and in the pump rooms there are two pipes on each side of the vessel for loading from or discharging into barges.

The two pump rooms are placed forward and aft of the bridge respectively, and each contains a 12-in. by 10-in. by 14-in. H. T. Duplex oil pump. These pumps have a capacity of 150 tons per hour. The connections in the pump rooms are so arranged that the pumps can draw either from the sea or any tank and deliver into any other tank, and any tank can be

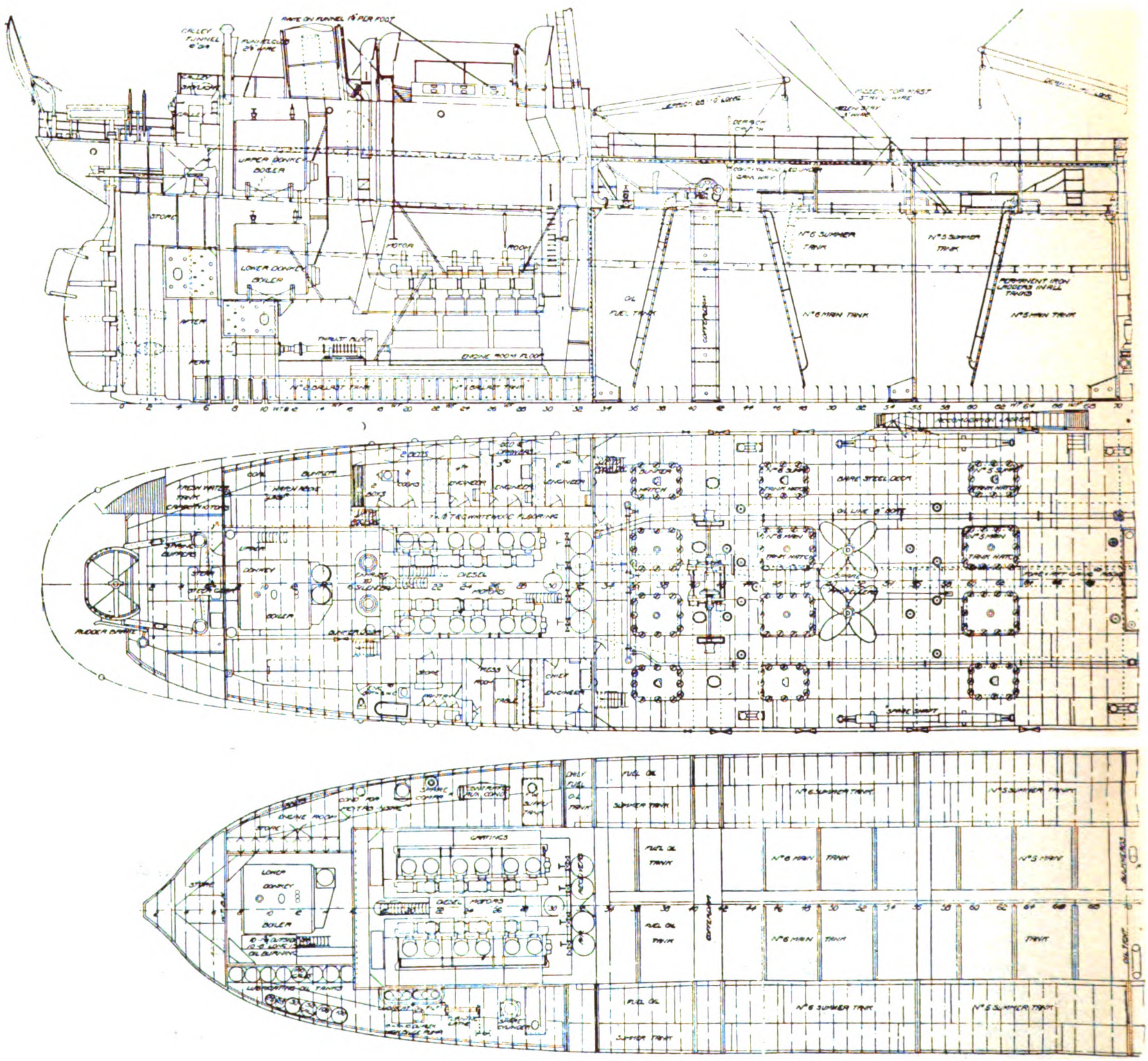


FIG. 1—INBOARD PROFILE AND DECK PLANS OF

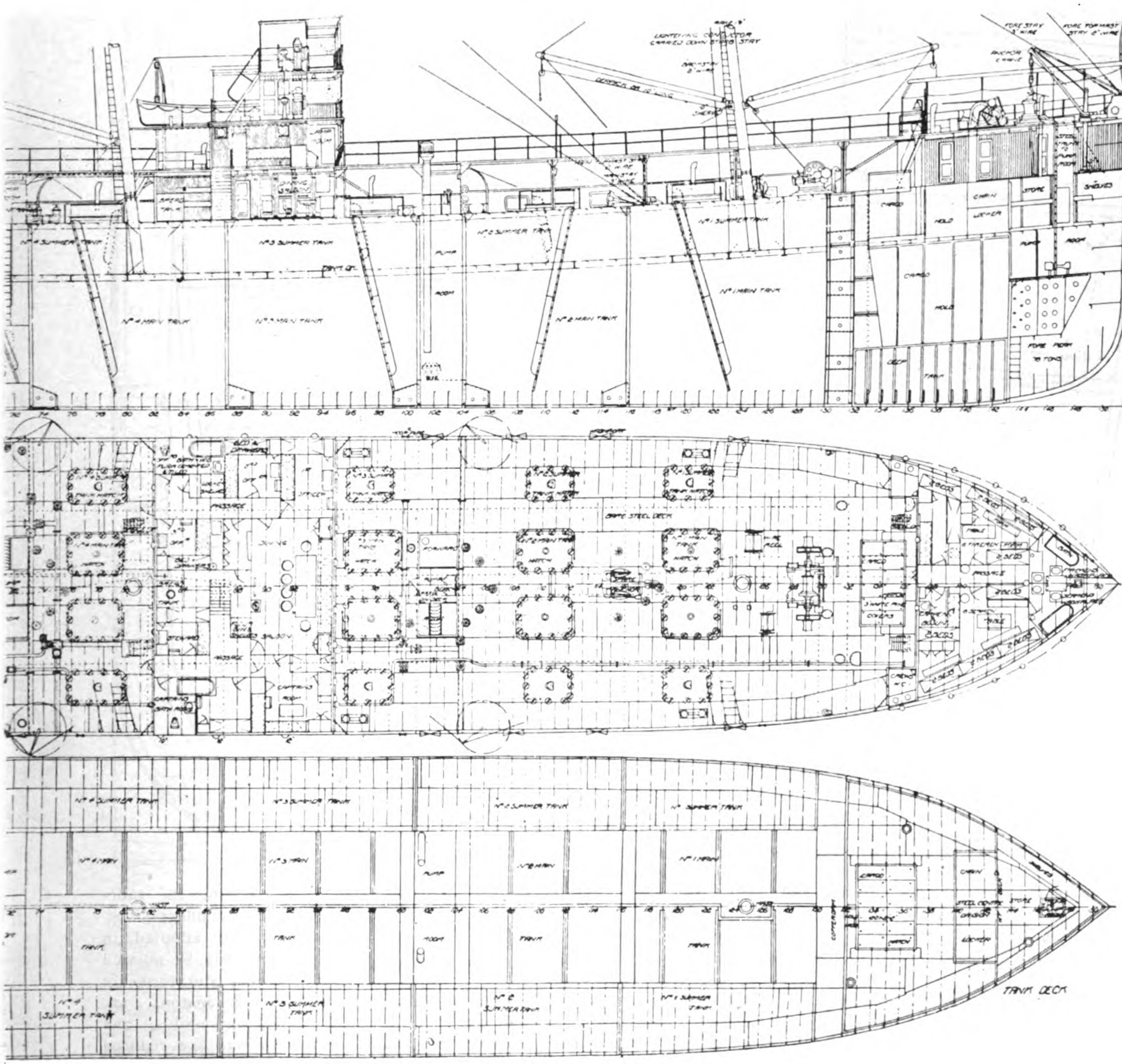
pumped out while another is being run or pumped up. A complete system of steaming-out pipes and vapor pipes has been fitted to the oil spaces, and wind sails have also been supplied to each main oil tank.

In the forepeag a 6-in. by 5¾-in by 6-in H. T. Duplex pump is fitted, with a 4-in. pipe line on deck, for the purpose of transferring liquid fuel from the reserve tanks forward to the fuel bunkers aft. This pipe can also be used for filling the reserve tanks. Another 6-in by 5¾-in. by 6-in. H. T. Duplex pump (ballast) is fitted in the forepeak and draws from the sea, forepeak ballast tank and bilges, and delivers into the forepeak ballast tank, overboard, and into the wash-deck line.

The deck machinery of the vessel consists of two steam winches, steam windlass, two steam capstans on the poop, and steam steering gear in the poop. The vessel has three telescopic masts so that she may pass under the bridges of the Manchester ship canal, and four large derricks are provided for discharging case oil when necessary. A complete installation of electric light is fitted throughout.

The accommodation for the officers and crew is of the usual good style fitted in this class of vessel. The captain and officers are housed in the bridge amidships, with a chart room above and a wheelhouse above the chart room. The engineers' accommodation is situated in the poop, and the seamen and engine-room hands are provided for in the forecastle. Special care has been taken with the ventilation, and all the rooms are provided with steam radiators.

The propelling machinery of the Sebastian, which has been constructed by the Aktiebolaget Diesels Motorer, of Stockholm, consists of two sets of marine "Polar" Diesel motors of the two-stroke cycle type (single-acting; direct-reversing), driving twin screws. Each motor consists of six working cylinders having a diameter of 17.72 in. and a stroke of 21.27 in.,



MOTOR-DRIVEN OIL TANKER SEBASTIAN

and on trial each set developed 800 B. H. P. at 165 revolutions per minute, or 1,600 B. H. P. collectively.

The bedplate is of cast iron, the crank pits forming an oil well. The main bearing bushes are of cast iron, lined with white metal, and have forced lubrication.

The cylinders are supported on cast iron columns and framing towards the center of the vessel, and on round steel columns towards the sides. The cast iron framing also carries the guide bars, the main air compressors, the bilge and circulating water pumps, etc. The cylinder liner and barrel are one casting, the space between forming a water jacket. The cylinder covers and piston are also water-cooled.

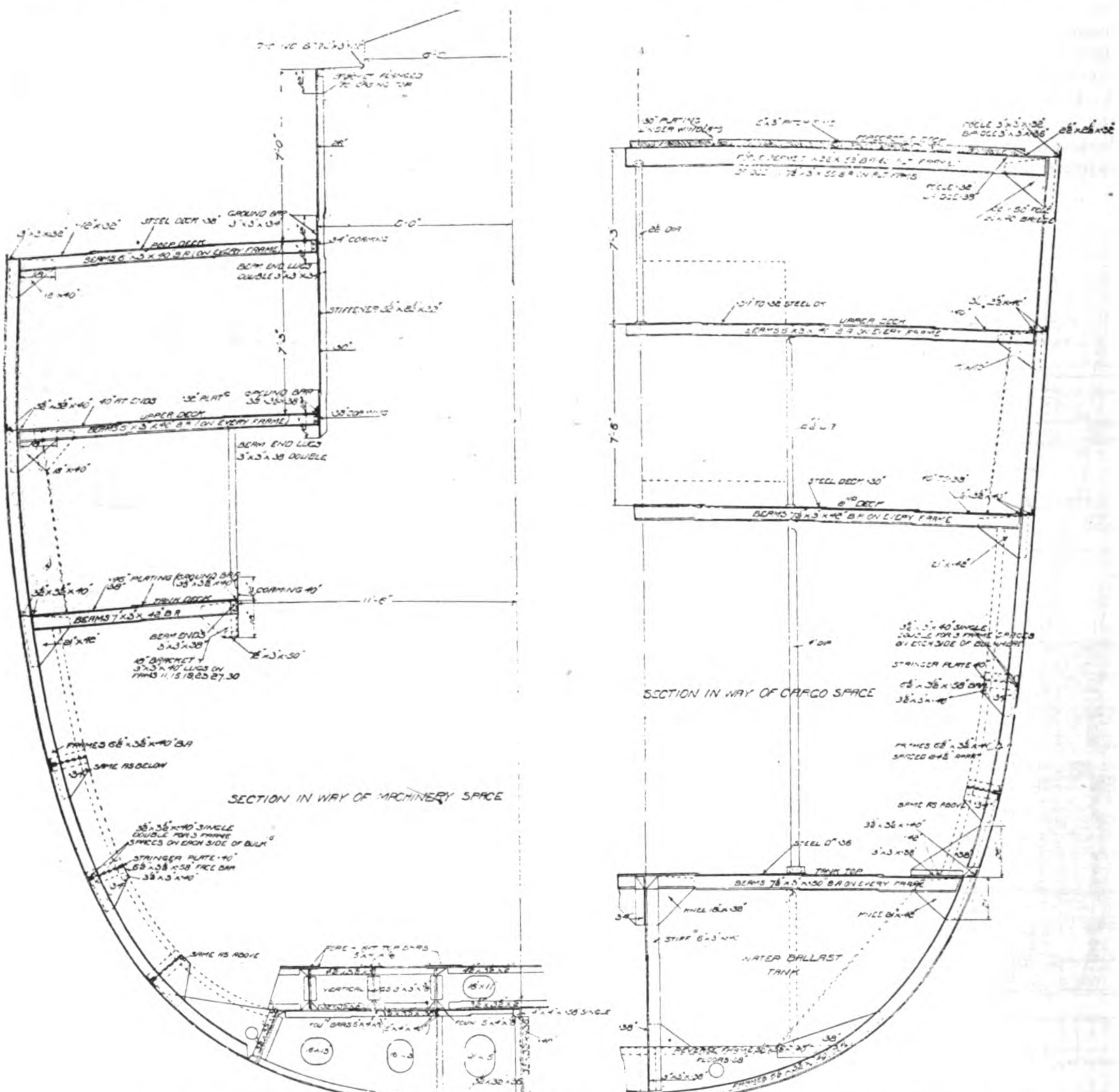


FIG. 3—SECTION AT FORWARD AND AFTER ENDS MOTOR-DRIVEN, OIL TANKER SEBASTIAN

The scavenging cylinders are situated immediately under the working cylinders. The pistons of the former are slightly larger than those of the working cylinders, and are mounted on the same piston rods. The working cylinders are scavenged through a port in the cylinder barrel, which is uncovered by the piston when approaching the bottom of its stroke.

The scavenging pistons also serve the purpose of starting or reversing the engine, as by an arrangement of piston valves, operated from the starting platform, air from the starting air receivers is admitted to the under side of these pistons at a pressure of 75 lbs. per sq. in., which causes the motors to revolve in the desired direction until one or other of the cylinders fire, when the starting air is cut off and the scavenging cylinders again come into operation.

The exhaust port is placed opposite the scavenging port, and, in order to obtain the best scavenging action for the incoming air, the piston head is so shaped as to project the scavenging air upwards, thus ensuring the thorough cleansing of the cylinders.

With the arrangement adopted in this type of engine, it may be pointed out the cylinder covers and tops are much simplified, the pistons are much more quickly accessible, and cams, levers and springs are reduced to a minimum.

To each motor are fitted four two-

stage air compressors, worked by levers and links from piston cross-heads, three being fitted for supplying injection air to the fuel valves and one for air to the starting air receivers.

The main motors drive the pumps for supplying cooling water to the pistons and jackets, and also actuate the bilge pumps and lubricating oil pumps.

The cam-shaft for operating the fuel valves is driven by gearing from the crank-shaft, different cams being brought into action for ahead and astern running. Eccentrics for operating the fuel pumps are also driven by this shaft, one fuel pump being provided for each cylinder. The daily service tanks are fitted above the tank deck, and the fuel oil gravitates through the heaters and filters to the fuel pumps. The fuel pump suction valves are controlled from the starting platform, and are also under the control of a governor in case of racing.

A turning engine, driven by steam or compressed air and of ample size to turn the main motors, is geared to each fly-wheel. In addition to the main air compressors on the motors, one Reavell auxiliary steam-driven air compressor and one independent auxiliary Diesel-driven air compressor are fitted on board to supply air to the storage air receivers.

Two multitubular donkey boilers are fitted at the after end of the engine room, as shown in Fig. 1, the lower boiler being fired by oil on the Meyer-Smith pressure jet system, and the upper boiler being adapted for burning either coal or oil. These boilers supply steam to the engine room auxiliaries, deck machinery, etc. There are also installed in the engine room an auxiliary condenser, with Hall's air and circulating pumps, the same makers' Duplex feed pumps, two bilge pumps, one ballast pump, one auxiliary oil feed pump, a feed heater and evaporator.

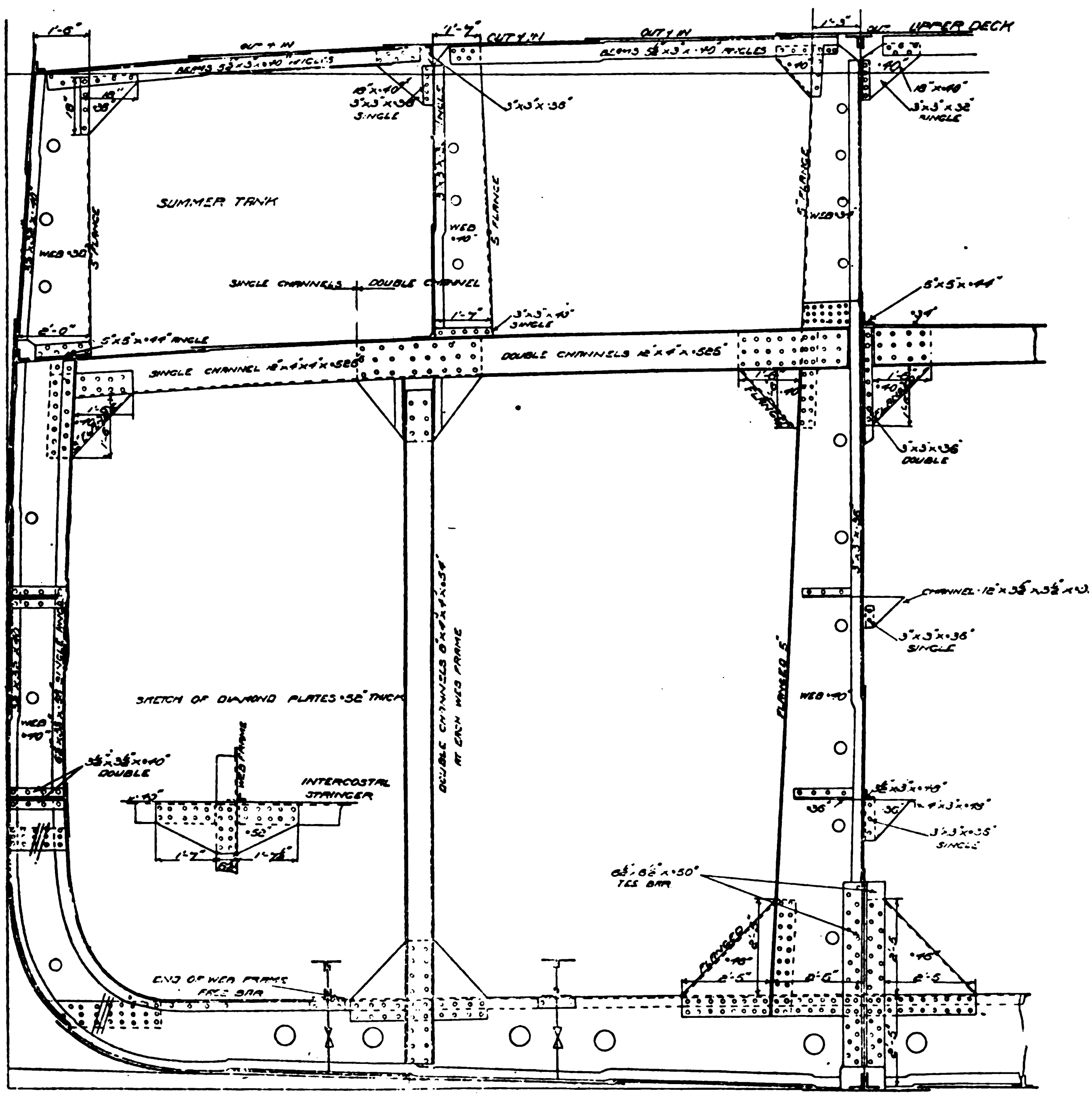


FIG. 4—SECTION AT WEB FRAME MOTOR-DRIVEN OIL TANKER SEBASTIAN

The Sebastian underwent a satisfac-

tory trial recently, obtaining a speed of a little over 11 knots on the measured mile, after which a continuous trial of 24 hours, duration was commenced. During the whole of the trials all parts of the machinery worked smoothly and to the entire satisfaction of the owners' representatives. On the voyage from Dundee to the Thames, the vessel was intentionally run at about three-fourths power, giving an average speed of nine knots at 104 R. P. M. The ship will be employed in the American-Spanish oil trade. The particulars embodied in this article were obtained from the shipbuilder, Newcastle-on-Tyne, England.

A Merit System

A System of Examinations for Promotion from Assistant to Chief Engineers' Grade on One of the Lake Fleets

ONE of the fleets operating on the great lakes has a system of examinations for promotion from assistant to chief engineer's grade. The examinations are written and the answers are to be prepared without assistance. A value is attached to each question and another value, equal to the sum of these, is attached to the candidate's practical and personal qualifications, including sobriety; attention to duty, cleanliness, initiative; care of men, property and supplies, etc., so that his service record counts equally with the technical but a passing mark of at least 80 per cent is required in the former and 65 per cent in the latter.

The same set of questions may be put to several candidates at one time but are not used a second time.

A typical set prepared for a recent examination is presented herewith. It will be seen that none calls for more than a knowledge of the simple rules of arithmetic and mensuration though some are framed to test the candidate's reasoning powers and his understanding of ordinary engineering problems. To this set one candidate's answers were 95 per cent correct.

It can scarcely be doubted that such tests of fitness are in the highest degree valuable to both candidates and owners.

1—State your age and experience in full.

2—Give, from memory or notes, the following particulars of the last ship you served on:
- A—Sizes of main engine.
- B—Sizes of air pump.
- C—Sizes of feed pump.
- D—Diameter and pitch of propeller.
- E—Diameter and length of boilers.
- F—Grate area.
- G—Number and diameter of tubes.

3—What are the objects of mechanical draft?

4—What are the objects of heating air before admission to furnaces?

5—What are the essential differences between positive and induced draft?

6—State the advantages of each.

7—What is smoke and what causes it?

8—How may it be prevented?

9—Is its prevention conductive to economy and to what extent?

10—How is the proper air pressure under fires determined?

11—What is the effect of an unnecessarily high pressure?

12—What is the effect of too low a pressure?

13—What natural law causes so-called "natural" draft?

14—How does height of smokestack affect it?

15—What is the most desirable stack temperature?

16—How are stack temperatures an indication of boiler efficiency?

17—How are stack temperatures affected by air leaks in induced or natural draft systems?

18—How are boiler efficiencies affected by air leaks?

19—Define circulation; state its effect upon the efficiency of a boiler.

20—In a flat surface supported by stays spaced 6 in. x 7 in. and carrying 150 pounds, what is the load upon the stay?

21—What should be the least area of a stay to support a load of 170 lb. per in. on a surface 6¼ in. x 6¾ in. allowing 6,000 lb. per sq. in. of section?

22—Suppose, on taking charge of a boiler, you found that the screw stays were carrying a load of 7,500 lb. each while the rules only allowed 7,000 lb., how can the condition be remedied without enlarging all stays and without reducing the working pressure?

23—The tubes in a boiler are 3¼ in. outside diameter, spaced 4¼ in. vertically and 4½ in. horizontally; the working pressure is 175 lb.; what is the load stayed by each tube?

24—Suppose you had to cut out and plug one tube, what would be the effect on the tubes immediately above and below and at each side?

25—If the above tubes are 3 in. inside diameter, what is the load per square inch of section?

26—A ship makes 12 miles per hour with a propeller 13 ft. diameter, 15 ft. pitch at 80 revolutions; what is the slip?

27—If the same propeller has 15 per cent slip, what will be the revolutions to make 12 miles?

28—Give the speed of ship with the same propeller at 75 revolutions and 12 per cent slip.

29—With the ordinary link gear, what is the effect of linking up on travel, admission, cut-off, release and compression?

30—A valve has 1¾ in. outside lap and no inside lap and a travel of 6¼ in.; what are the steam and exhaust openings?

31—If the travel is reduced to 5¾ in., what will the openings be?

32—Can eccentrics be set without moving the engine from one center, and if so, how?

33—If the link is placed in mid-gear and the engine turned, what will be the movement of the valve?

34—Suppose one eccentric to have slipped, how can it be quickly reset without tramming or moving engine?

35—If a link is ordinarily run hooked up and the backing eccentric should slip slightly, what would be the effect on the go-ahead motion?

36—In what important respect does the operation of the Joy gear differ from the link?

37—How does hooking up in a Joy gear affect valve movement and events as named in Question 29?

38—Describe the process of setting a Joy valve gear.

39—If a valve 4 in. diameter is placed in a 3-in. pipe line, how much lift should it have to give same area of opening as the line?

40—In a 3-in. pipe the flow of water is 300 ft. per minute with a 3-in. valve on the line open ⅜ in.

What is the rate of flow through the valve?

41—A 4-in. steam pipe has an opening with an area of 1 sq. in. at one end through which steam is flowing at the rate of 10,000 ft. per min., what is the rate of flow in the pipe?

42—A column of water 1 ft. high exerts a pressure of 0.43 lb. A pump located 12 ft. below the water line and taking water from the sea has to lift to a height of 35 ft. above the pump. What pressure has the pump to overcome?

43—A pump has a steam cylinder 9 in. diameter and an available steam pressure of 100 lb. The water end is 5 in. diameter. Assuming 10 per cent to be absorbed in friction, what water pressure is obtainable?

44—A feed pump has a single water cylinder 7 in. diameter and 18 in. stroke and makes ten strokes per minute each way. How many pounds of water does it deliver, assuming 61¾ lb. per cu. ft.?

45—Assuming an evaporation rate of 10 lb. water per pound of coal, how much coal per hour will be required to evaporate it?

46—A ship needs a new feed pump. Her high pressure cylinder is 20-in. diameter, 42-in. stroke. Her full-gear cut-off is 32 in. and her revolutions 85 per minute. The steam she uses weighs 0.38 lb. per cu. ft. To this is to be added 15 per cent for clearance and various auxiliaries. How many cubic feet of water per minute must be provided for at 61¾ lb. per cu. ft.

47—Adding 50 per cent to the above for slippage, etc., what size single pump will be required at 10 double strokes per minute?

48—The auxiliaries of a ship use 10 per cent of the total coal burned. The temperature of the hot well is 140 deg. The temperature of the feed water due to heat recovered from auxiliaries is 204 deg. If each degree is equal to 0.1 per cent fuel, what is the net coal used by auxiliaries?

49—A ship has a bunker 12 x 40 ft. in which the depth of coal averages 8 ft. At 42 cu. ft. per ton, how many hours can she steam burning 1,500 lb. per hour?

50—A ship has coal to steam 100 miles at 12 miles per hour, using 2,000 lb. per hour. By reducing speed to 10 miles and her coal to 1,200 lb. per hour, how far can she steam?

Daily Weather Bulletin by Radio

It is announced that beginning June 1, 1914, a daily weather bulletin for the Great Lakes will be distributed broadcast by the naval radio station at Radio, Va., a few minutes after 10 p. m., each day, immediately after the bulletin for the North Atlantic Ocean and Gulf of Mexico. The broadcast distribution of this bulletin will be exclusively by the naval radio station named.

The daily bulletin will consist of two parts. The first part will contain code letters and figures which will express the actual weather conditions at 8 p. m., 75th meridian time, on the day of distribution at certain points along the Great Lakes. The second part of the bulletin will contain a special forecast of the probable winds to be experienced on the Lakes made by the United States Weather Bureau for distribution to shipmasters by naval radio as above during the season of navigation on the Great Lakes—about April 15 to Dec. 10.

The points for which weather conditions will be furnished will be designated as follows: *Du* = Duluth, *M* = Marquette, *U* = Sault Ste Marie, *G* = Green Bay, *Ch* = Chicago, *L* = Alpena, *D* = Detroit, *V* = Cleveland, *F* = Buffalo. The grouping has been by lakes beginning with Superior and ending with Erie.

The bulletin will begin with the letters U S W B for U. S. Weather Bureau, and the weather conditions will follow. The first three figures of a report will represent a barometric pressure in inches (0.02 = 30.02); the next figure, the fourth in sequence, will represent the direction of the wind to eight points of the compass: 1 = north, 2 = northeast, 3 = east, 4 = southeast, 5 = south, 6 = southwest, 7 = west, 8 = northwest, and 0 = calm. The fifth figure will represent the force of the wind on the Beaufort scale.

Beaufort Scale

Force.	Designation.	Miles per hour
0	Calm	From 0 to 3
1	Light air	Over 3 to 8
2	Light breeze (or wind)	Over 8 to 13
3	Gentle breeze (or wind)	Over 13 to 18
4	Moderate breeze (or wind)	Over 18 to 23
5	Fresh breeze (or wind)	Over 23 to 28
6	Strong breeze (or wind)	Over 28 to 34
7	Moderate gale	Over 34 to 40
8	Fresh gale	Over 40 to 48
9	Strong gale	Over 48 to 56
10	Whole gale	Over 56 to 65
11	Storm	Over 65 to 75
12	Hurricane	Over 75

In order to simplify the code no provision has been made for wind force greater than 9, strong gale on the Beaufort scale. Whenever winds of force greater than 9 occur the number representing them will be given in words instead of figures, thus: ten, eleven, etc. If the weather conditions from any station cannot be supplied, the initial of the station will be given followed by the word "missing", and if any portion of a report cannot be furnished, such portion will be replaced by an equivalent number of letters "x".

Example of Code

U S W B Du 95826 M 97635 U 00443 G 96046 Ch 95667 L 00644 D 00842 V 01054 F 01656.

Translation

United States Weather Bureau.

Stations.	Pressure.	Wind. Direction.	Wind. Force.
Duluth	29.58	NE.	6
Marquette	29.76	E.	5
Sault Ste. Marie	30.04	SE.	3
Green Bay	29.60	SE.	6
Chicago	29.56	SW.	7
Alpena	30.06	SE.	4
Detroit	30.08	SE.	2
Cleveland	30.10	S.	4
Buffalo	30.16	S.	6

The second part of the bulletin will contain a wind forecast for the Great Lakes, Lakes Superior, Michigan and Huron being considered the Upper Lakes, and Lakes Erie and Ontario the Lower Lakes.

The forecasts and warnings will be in ordinary language and will cover a period of 24 hours from time of issue. At the end of the forecasts a statement will be made in reference to the location and movement of any barometric depression that may be likely to affect the winds over the lakes.

Example of Forecasts and Warnings

"Winds Thursday on the Upper Lakes strong east to northeast, probably reaching gale force. On Lower Lakes, fresh to strong east and southeast winds. Northeast storm warnings are displayed on Lakes Superior, Michigan and Huron."

The Lighthouse Board has accepted the bid of Hall Brothers, Winslow, Wash., for the construction of the lighthouse tender Fern, to cost $62,000, for service in Alaskan waters and to take the place of the Armeria lost about two years ago.

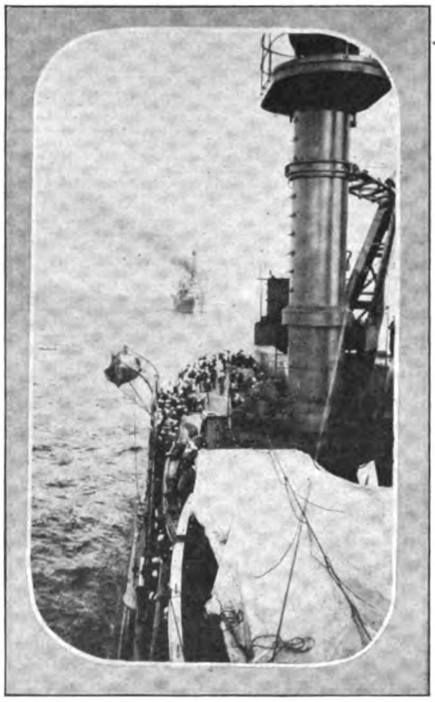
The sidewheel steel ferryboat Hanover, 180 by 32 by 9 ft. built by the Harlan & Hollingsworth Corp., Wilmington, Del., for the Louisville Navigation Co., made a satisfactory trial trip on May 27, and will be ready for service on the first of June.

THESE ARE SOME OF THE MEN THAT LANDED AT VERA CRUZ ON APRIL 21

IN ATTEMPTING to appreciate the work of a battleship, one must keep constantly before him the fact that a fighting ship is primarily a gigantic floating fort, and that the details of its organization are dictated by the necessity of fighting rather than the necessity of navigating. Two things require constant consideration: First, the personnel, consisting of about 1,000 officers and men; second, the material, including ships, guns and engines with the thousand and one accessories necessary to keep these up to the highest point of efficiency.

A first-class battleship of the Utah type stands on the government inventory at from $7,500,000 to $10,000,000, with a yearly running expense of about $1,000,000, including pay and subsistence of officers and men, ship up-keep and target expenses, a large and expensive plant even when compared with great industrial organizations.

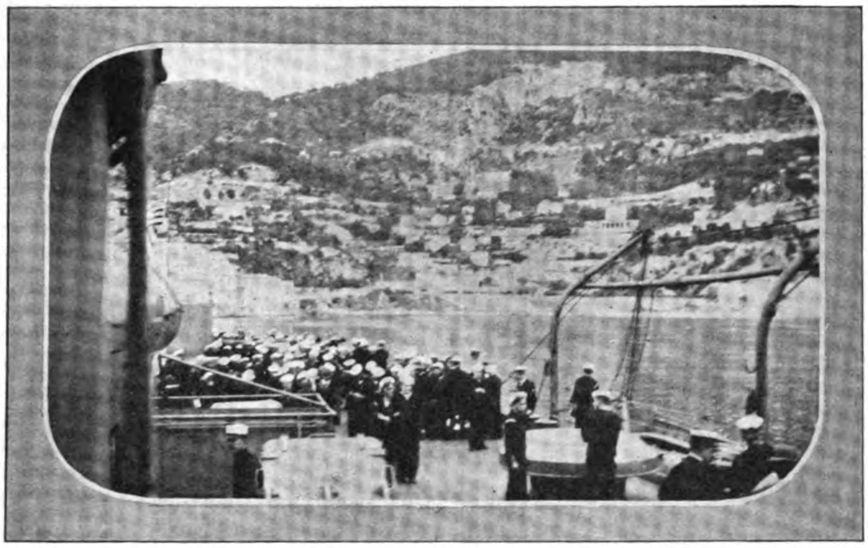
The captain has absolute authority (except for the thousands of rules laid down in the United States naval regulations), and is personally responsible for the safety of his ship and the efficiency of both its material and personnel. He leads a somewhat lonely life, having his own cabin and his own dining room apart from the rest of the officers and maintaining an aloofness which is considered necessary for discipline. Under him are the wardroom officers, presided over by the executive officer or commander, who is directly responsible for the personnel, that is, the organization of the officers and men who compose the ship's crew. Next in rank are the department heads; the first lieutenant, who has charge of the material, the repairs, upkeep, cleanliness, etc., of the ship from one end to the other; the navigating officer, who is responsible to the captain for the detail work of conducting the ship from



THE FLEET PASSING GIBRALTAR

place to place; the engineer officer, who has charge of all machinery; the ordnance officer, who must answer for the condition of the batteries and the efficiency of their crews; the paymaster, who looks after the provisions and stores of all kinds and the feeding of the men, and the medical officer who is responsible for the ship's health, both in time of peace and time of war. These are followed by the division officers, men who stand the regular bridge watches and who, in addition, have charge of certain compartments and have a division of about 60 men for whose training, efficiency and readiness they are personally responsible. The first five are assigned to turrets and each one is directly responsible for the up-keep of its guns and the efficiency of its crew in time of target practice or battle. Then come junior officers, young fellows recently from the academy, who have their own mess and quarters where they can give vent to the exuberances of their spirits without fear of being frowned upon by superior age and who act as assistants to the other officers. Below these are the warrant officers, men who have risen from the ranks to a position equal to that of ensign and who likewise have their own mess and own quarters. The chief petty officers, petty officers of the first, second and third class, seamen, ordinary seamen and apprentice seamen, firemen, coal passers, artificers of almost any kind, messmen, etc., make up the balance of a seemingly complicated but in reality rather simple and highly efficient organization in which, contrary to the ordinary conception, any man can become a commissioned officer provided he has brains and training to pass the examinations required of other officers. The big ship is full of men who often seem to have little to do, but when general quarters are

sounded and battle stations manned, every man has his station and his work and he performs it with an efficiency not surpassed in any other calling in the world.



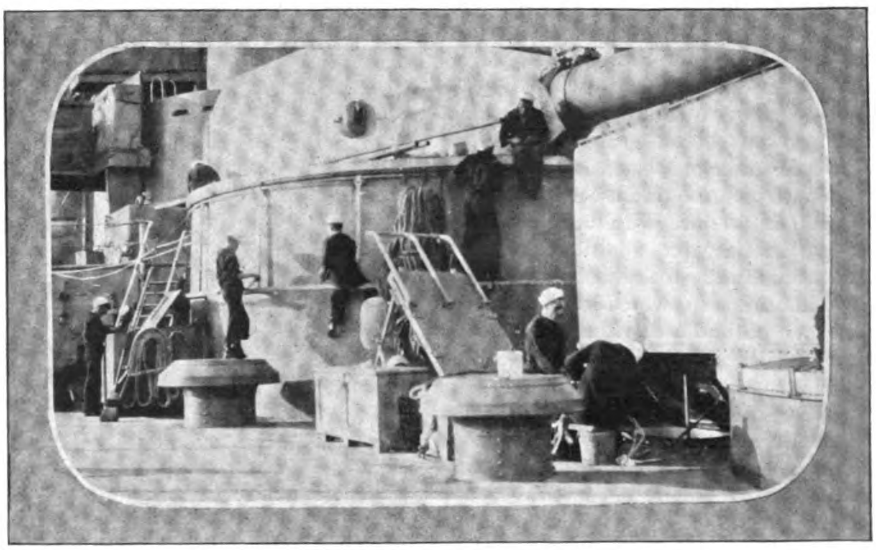
WAITING FOR THE MAIL FROM HOME

A day's routine aboard a man of war is precise, but not difficult.

All hands except those having the night watch are called at 5:00 a. m., coffee being served before work is started. At 5:30 the decks are swept and scrubbed down and any special morning orders executed. At 7:00 the balance of the hammocks come down, and the uniform for the day is announced, breakfast being served at 7:30. Bright work is piped at 8:15, and at 9:15 all hands muster at quarters for inspection and physical exercise, which is followed by such drills as may be ordered to take up the time until 11:15. Dinner is served at 12:00 and from 12:30 till 1:00 the band plays and the men amuse themselves listening, dancing or in any other way they choose. The period from 1:15 to 4:00 is used for drills or ship work, consisting of painting, scraping or anything else that may be necessary to keep the ship in order. Regular work ceases at 4:00 and supper is served at 5:30 or 6:00, depending on the season, after which another band concert takes place, followed by boxing, wrestling or moving picture shows. Hammocks are piped at 7:30 and tattoo with its accompanying silence is sounded at 9:00. This routine is of course independent from the actual work of navigating the ship and handling the engine room, which is divided into four-hour watches except that in order to secure a proper rotation, the afternoon watch is divided; the first dog-watch being from 4 to 6 and the second dog-watch from 6 to 8. Wednesday and Saturday afternoons and all day Sunday are periods of rest except for such work as is required in the actual handling of the ship

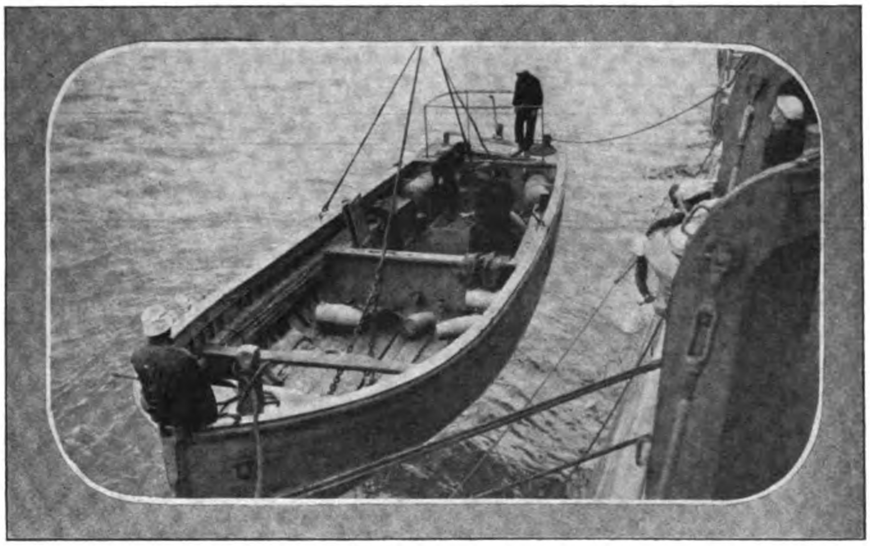
Naturally I was most interested in the routine of the navigational division and found my assignment as assistant navigator a most interesting and instructive one. For while I have special master's papers on the lakes, and had given some study to the theory of astronomical navigation and the handling of a sextant, the actual working out of latitude and longitude sights and the determining of a ship's position by such means was entirely new, but under my orders to do a "day's wórk" as prescribed for a navigator, I had no course but to turn to and learn as quickly as possible.

The regulations provide that the navigator report the position of the ship by dead-reckoning and observation at 8:00 a. m. to the captain and at noon and at 8:00 p. m. to both the captain and the commanding officer of the fleet. The first position is practically always a dead-reckoning position; the noon position an astronomical fix and the evening position a combination of afternoon sights and dead reckoning. As early as possible after the sun was 10 degrees above the horizon, we took our first sight for longitude, taking an azimuth of the sun at the same time, both in order to check our compasses and because this is required in solving the problem for position. In working this position out, the dead reckoning position of the ship at the time of observation is used and the result shows that the ship is actually on a line perpendicular to a line running from the dead reckoning position of the ship to the sun, either nearer to or farther away from the sun than this D. R. position by the number of miles shown by the result of the computation. As the ship may be anywhere on this line, the information is of value only in connection with a second observation giving another line at an angle to the first so that an intersection of the two can give a definite position. In order to get these lines, it was our practice to take at least two more observations before 11:00 o'clock. In addition it was necessary to check up the compasses for deviation which is large and constantly varying, to figure out the correction to be applied to the chronometer on account of the change of longitude and to compute tables for determining the meridian altitude of the sun a few minutes in advance of noon. In the meantime the navigator and his assistants relieved the officers of the deck at 9:15 to allow the latter to go to the quarters for drill and handled the ship until retreat was sounded at about 11:00 o'clock. From 11:40 to



SCRAPING AND PAINTING

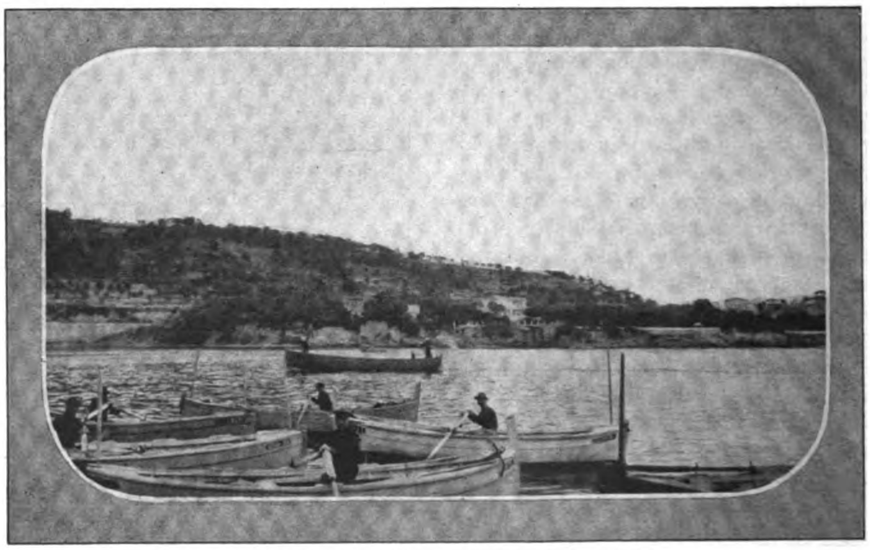
11:55 observations were taken for latitude, and the results of these with a mean of the longitudinal lines taken during the morning, gave an accurate position of the ship at noon. This was bent on the signal halyard, and at the first stroke of the bell, shot up to the yard arm as a report of our position to the admiral, after which the coal used during the last 24 hours and the coal on hand at noon were reported. The noon position and the distance run since the preceding noon was then entered on the charts, both in the chart house and on the officers' and crew's bulletin board and the noon dead reckoning position corrected. At about 1:30 and again around 3:30 longitude observations were taken, and when the weather was propitious, just at dusk, as the first of the stars came out and before the horizon became obscured, star sights were taken as a final check on the position. These are especially valuable because of their accuracy and because an observation of two of them properly selected gives two lines whose intersection establishes a fix at once without the necessity of waiting for additional sights. It is sometimes difficult, however, to get conditions in which one can see distinctly both the stars and the horizon, as these two factors are absolutely essential. The determining and reporting of the 8:00 p. m. position concludes the navigator's day's work while at sea, although within sight of land his work is governed entirely by the exigencies of the situation and requires constant vigilance both day and night.



HOISTING A CUTTER BY ELECTRIC CRANE

I have been asked a good many times as to whether a knowledge of this work would be of value to men sailing the lakes, and am decidedly of the opinion that only in very rare instances would the ability to work out the latitude and longitude observations be of any benefit on these waters. Our distance between lights on ordinary courses is too short to make astronomical navigation of any real value, and the fact that our horizon is so often obscured by fog or smoke or is interrupted by the land, would make it impossible to get satisfactory results. The noon positions as reported by the various ships supposed to have equally good navigators varied from 10 to 20 miles, which would not do for lake sailing. I have seen some cases where early morning star sights might have been of some value, but these are too rare to pay for the time and attention necessary to master and become expert in the solving of these problems. The great lakes captain has already too many things which it is absolutely necessary for him to master thoroughly to bother with this subject which would at best be of questionable value to him.

It is generally realized that the naval battle of the future will be a matter of seconds and minutes and not of hours, and as a result the problem constantly confronting the commander-in-chief is to have every crew ready to do the most efficient fighting in the quickest possible time. As a result, the period from 9:15 to 11:30 daily is devoted to drills covering some phase of preparation for battle. Fifteen to 20 minutes of vigorous setting up exercises based on the new and highly scientific Swedish movement serve to keep the men in health and to build up as fine a body of men from a physical standpoint as can be found anywhere. On this particular trip the probability of action in Mexico was daily before us and largely influenced the nature of the drills. Tenting and field canvas were gotten out and aired; the battalion was equipped with packs for landing; knapsacks were overhauled and re-packed and an unusual amount of time was spent on infantry and small arms drill. To one familiar with this careful preparation last fall, the machine-like precision with which the blue jackets and marines from the Utah and the Florida took the customs house at Vera Cruz on April 21 and 22 came as no surprise. Fire drill, collision drill and abandon-ship drill all had their place, but more important than all others from a naval standpoint was the daily work with the big guns. The careful daily training which alone can make possible the efficiency of the ships as they go on the range for battle target practice includes the actual work of loading with dummy ammunition sighting at a supposed enemy (either the colliers or the other division of the battleship) checking the sighting by means of an umpire and extra instruments to see



CURIOUS FRENCH ROWBOATS ABOUT THE FLEET

that it is correctly done, all the work being done in competition, one turret with the other and each ship with the rest of the fleet, with the time accurately taken with a stop watch. Every day or two the decks were actually cleared for action, i. e., everything gotten ready for real fighting, stations manned, guns loaded and trained, all the work carefully gone through with that would actually be done in case an enemy were sighted, this being performed in competition with the other ships in the fleet and *seven to eight minutes were sufficient to transform these vessels from peaceful ships to demons of destruction, ready to hurl their message of death against an enemy eight miles distant!*

At 7:00 p. m. every night when the weather permitted the opening of the lower gun ports, torpedo defense drill call was sounded and the 5-in. battery which is used for the repulsion of torpedo boats was manned and gotten ready for action. All lights were turned off, leaving the ships in absolute darkness, the searchlights turned on and the ships in turn picked up the targets with their lights while the guns were aimed and the pointing checked. The difference in visibility between the Solace, which was painted the white of the old navy and the colliers with their grim coats of war gray, was very noticeable.

Each ship in the fleet has a definite position which it is required to keep. In column one is directly behind another at a distance of 500 yards measured from bridge to bridge. If a ship varies by more than 40 yards from this distance, either over or under, the watch officer must hoist his position pennant half way up denoting that he realizes he is out of position and is endeavoring to get back in. If he does not do so the admiral calls his attention to the fact, a proceeding which is not pleasant. The result is that an officer by means of an instrument called a stadimeter, checks up the distance between ships, this being done continually at intervals of two to four minutes. The engine revolutions have to be carefully watched as a slight variation will throw the ship out of position. The turbine-driven screws revolve at a much higher rate than those driven by reciprocating engines, ours turning up 186 r. p. m. for 12½ knots speed. If we started to drop back the speed would be increased two or four revolutions, while if we gained on our position they would be dropped down to 184 or 182, etc. The distance had to be constantly watched and good judgment used in changing the speeds, for if these big ships once get to seesawing back and forth it is almost impossible to steady them down in position again without the loss of a great deal of time. The regular cruising formation at night was "column open order", in which the second ship is two degrees on the starboard quarter of the flagship, the third ship three degrees on the port quarter, the fourth ship following the second, etc. This gives more room to maneuver in case of accident to a ship ahead and consequently relieves to some extent the strain upon the officer of the watch. The favorite formation during the day time and the one which was the despair of the watch officers was known as "line of bearings", in which each ship took position at a certain angle (say 30 degrees on the starboard quarter of the preceding ship) distance as before, 500 yards. In this case both distance and angle had to be absolutely maintained, a task which required constant vigilance and the exercise of care and good judgment.

Almost every other night after the day's work had been finished, all officers not on duty were ordered to report in the spare cabin to play war games. This is a new departure in the fleet, a sort of a correspondence school conducted by the war college to give the officers training and insight into the strategy of war, which is distinct from the ordinary routine of handling a ship. A problem is handed out in which war exists between two nations and the size and condition of two fleets together with the respective object of each is given. The officers are divided into two sides, each one assigned to one fleet and they are required to maneuver and handle the fleet the same as though in battle in an endeavor to accomplish the object each has in view. In the center of the room is a large checkerboard divided into spaces 1 in. square each of which represents 600 yards of searoom. Each move on the board represents three minutes. The commander of each fleet writes out his orders and hands them to the umpire who directs that the move be made upon the board. It is required, however, that the order for move No. 3 be in the umpire's hands before move No. 1 is executed. When the ships have come in range, they open fire, each commander telling what guns he is using and against which one of the enemy's ships. By means of tables which have been carefully worked out and the use of dice to lend an element of chance, the probable result of the gun fire is figured and the number of hits determined. When the various ships are hit a sufficient number of times, they are declared to be slowed down, disabled or sunk and the battle goes on until in the judgment of the umpire one side or the other has accomplished its object or until it becomes so late that the executive officer decides it is time for his men to turn in. It is a very instructive game and often times gets decidedly exciting before the evening is over, but after a hard day's work, it cannot be looked at otherwise than as grim duty rather than a pleasure. Other battle problems are handed out on which each officer sends in a written report detailing the way in which he would handle it in case he were responsible.

Take it all in all, the fleet at sea is a hard working organization in which the officers at least, are under a constant strain with plenty of work always ahead and little spare time for either amusement or recreation. No business man could take a trip of this kind without having increased admiration and respect for the officers who go down to sea in our fighting ships.

Docking the Vaterland

The Hamburg-American liner Vaterland, which caused a commotion on her arrival at New York, furnished more excitement when she left on her first return voyage to her home port. Not only did she back out of her pier in Hoboken with sufficient impetus to carry her to the New York shore, three-quarters of a mile away, but she sank a coal barge and nearly wrecked two Morgan Line steamships. The stern of the Vaterland went into the slip between Piers 50 and 51, and for a moment it appeared that she would not stop short of the West street bulkhead. Tugs were unable to check her and a crash was averted by energetic action of the ship's own propellers. The coal barge Ulster, belonging to the Dexter & Carpenter Coal Co., which was lying in the slip, smashed against the pier and sank. Her captain was rescued with difficulty. The Pennsylvania lighter No. 424 and the Southern Pacific lighter Oakland were badly damaged and the piers were splintered by the force of the vessels bumping against them. The Southern Pacific Steamships El Valle and Topila, lying on each side of the slip, broke their moorings and crashed into the end of the slip, shattering the bulkhead and twisting the iron sheeting with which the building there is protected. Handling these giant liners in port is a problem in itself, the element of suction caused by propeller action being very pronounced.

The Staten Island Shipbuilding Co., Port Richmond, S. I., was the lowest bidder for the three steel tugs to be built for the Panama canal.

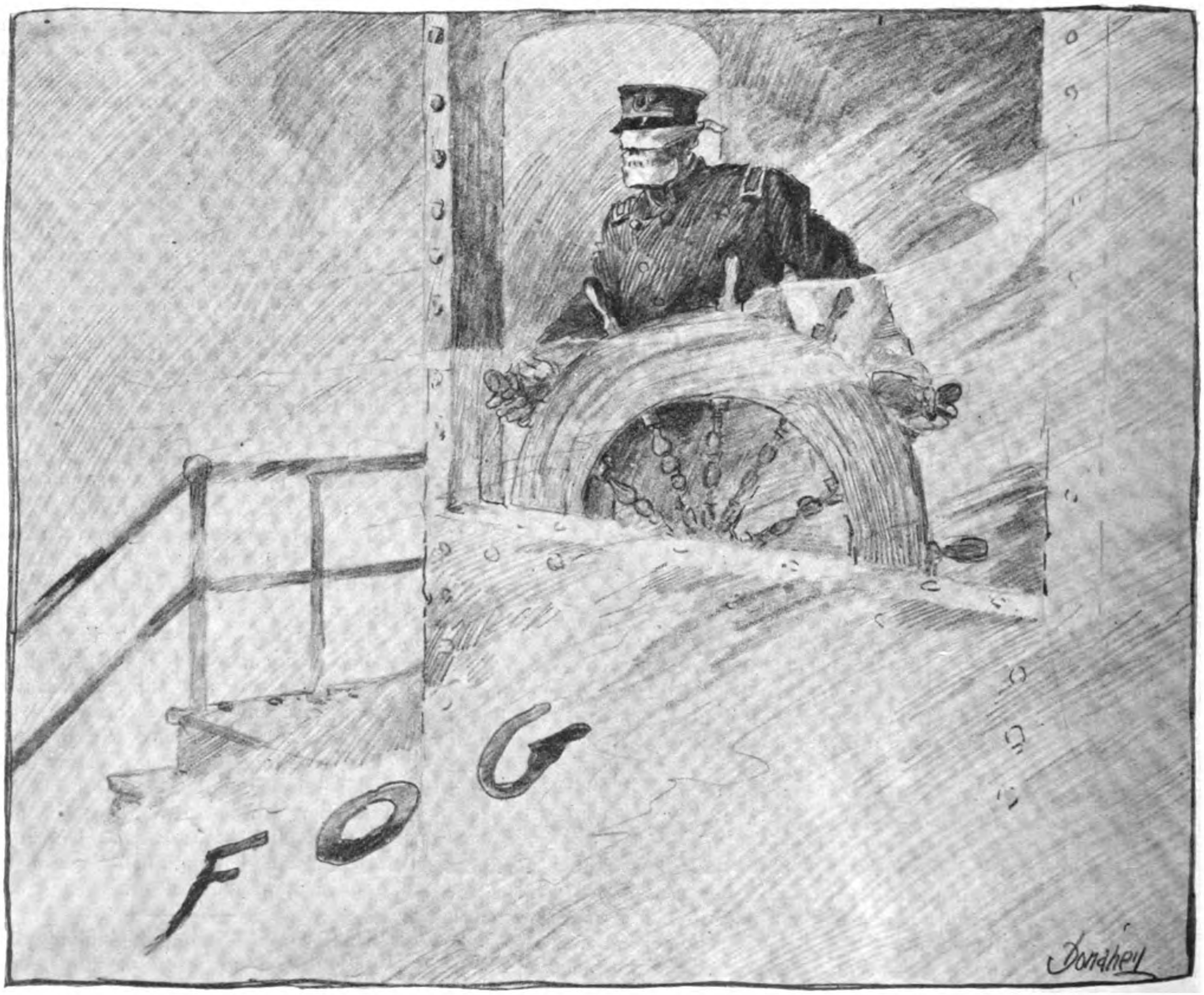
Another Sea Tragedy

The Canadian Pacific Empress of Ireland is Sunk in Collision with the Collier Storstad in the St. Lawence River—Steamer Gilbert Sunk on the Lakes

ANOTHER tragedy of the sea has occurred which will rank among the world's great tragedies in that over a thousand lives were lost. The Canadian Pacific liner Empress of Ireland was sunk in collision with the collier Storstad about 15 miles above Father Point in the St. Lawrence river. The Empress of Ireland had just left Quebec with a full passenger list while the collier was downbound with a cargo of coal. While the two vessels were in sight of each other and scarcely more than two miles apart, a slight fog bank developed between them. The testimony is conflicting as to what actually happened after that. Capt. Kendall, of the Empress, says that he immediately put his engine astern, then stopped and signalled to the Storstad that he was without headway. A moment or two later the Storstad showed up and rammed the liner amidships with her starboard bow. In his original statement Capt. Kendall said that he megaphoned to the Storstad to go astern, meanwhile ordering his own ship full speed ahead to avoid a collision, but that the impact occurred before the engines could respond to the signal. He added that he then begged the Storstad to hold her bow in the hole that she had made but that the Storstad backed out.

Capt. Anderson, of the Storstad, tells a different story. He says that the Storstad was going astern but that when he saw the collision was inevitable he grasped the engine telegraph to order her full speed ahead as soon as the impact took place in order that the vessels might sustain themselves, but that the Empress was going at the time at such a rate of speed that it was impossible to keep her bow in the hole, and that in fact it was twisted in the effort to do so. He was of opinion that his own ship had received a mortal injury, and so stated to his wife, who was on the bridge with him. She expressed surprise that the liner should not have stood by and did not regard her as seriously injured until cries were heard coming from the water.

There is a great mass of conflicting testimony in the newspapers from which it is utterly impossible to arrive at the exact truth. The Storstad's crew was accused by passengers on the liner of exhibiting indifference in



WHAT'S AHEAD?

Donahey, in the Cleveland Plain Dealer

the work of rescue, whereas the Storstad's crew maintained that all their life boats were put over immediately and that they rescued the great majority of the passengers, even charging that members of the crew of the Empress rescued refused to help in the work when brought aboard the Storstad. These statements seem incredible.

Above all the bitterness, accusations and incriminations there is one great outstanding fact and that is that the collision would never have occurred had the pilot rules been observed by both vessels. If both vessels had got down immediately to bare steerageway and then had picked their way past each other, there would have been no collision.

It is a very fortunate thing that the board of inquiry is to be presided over by Lord Mersey who conducted the inquiry into the Titanic disaster. There is no man living better qualified by training, temperament and judicial fitness for this work. His experience in admiralty affairs has been vast and he cannot be misled.

The steamer, W. H. Gilbert, owned by the Lakewood Steamship Co., was sunk in collision with the steamer Caldera, owned by the Kinney Steamship Co., about 15 miles south of Thunder Bay about 6:45 a. m., May 22. The Gilbert was upbound with coal and is said to have been on the inside course. The Caldera was downbound light. The Caldera struck the Gilbert amidships with such force as to practically cut her in two, and were it not for the fact that the Caldera was able to hold her bow into the hole that she made, lives might have been lost, as it is estimated that the Gilbert sank within five minutes thereafter. Fortunately all the crew were up at the time.

The condition of the Caldera's bow shows that she struck the Gilbert squarely head-on, and that at the moment of impact the ships must have been practically at right angles. An examination of the Caldera's injuries in dry dock shows that her stem is not damaged. She is stove in on either side from 20 to 30 ft. and her plates and frames are damaged as far back as the collision bulkhead, which is sprung on one side and punctured on the other. Experts who examined her say that she had a close call in that her side tanks were all that kept her afloat. That the blow was a terrific one is shown by the fact that in backing out the Caldera carried with her part of the Gilbert's decks, hatch covers and some of her coal cargo. Now the collision would not have occurred and obviously no such mortal damage done had the pilot rules been strictly observed.

There are certain points of similarity between the accident to the Empress of Ireland and to the Gilbert. If the Storstad had been able to hold her bow into the hole that she had made in the side of the Empress, the chances are that practically every life would have been saved, but Capt. Anderson is emphatic in saying that although he ordered his steamer full speed ahead as soon as the impact took place, he was unable to do so, his stern being swung around in line with the liner owing to the latter's headway. In the case of the Gilbert this maneuver was, as stated, successfully accomplished. The Gilbert was not insured and law suits will undoubtedly follow.

Lovely Weather We're Having

Senator Chamberlain, of Oregon, has introduced a bill in the senate for the collection of tolls from vessels passing through the canal at Sault Ste. Marie, as follows:

"That, upon boats, vessels, or floating craft of any description, other than those propelled by hand, passing through the canals and locks at Saint Marys Falls, in the state of Michigan, there shall be levied and collected a toll of 10 cents per ton of 2,000 pounds, and upon each passenger a toll of $1: Provided, That the toll upon vessels in ballast, including pleasure boats and those engaged exclusively in passenger traffic, shall be 60 per cent of the toll collected from vessels with cargo."

New Passenger Steamer Noronic

The new passenger steamer Noronic, of the Northern Navigation Co.'s fleet, visited Cleveland on June 2 for purposes of inspection, the company having decided to make Cleveland a port of call during 1914 for at least one of its vessels.

The Noronic is owned by the Canada Steamship Lines, Ltd., which is the name under which various Canadian steamship lines were recently merged. James Carruthers, of Montreal, president; Capt. J. W. Norcross, of Toronto, managing director, and H. B. Smith, of Owen Sound, president of the Northern Navigation Co., visited Cleveland on the new steamer.

The Noronic was built at the Port Arthur yard of the American Ship Building Co., and in her type is not excelled by anything afloat on the lakes. She is 385 ft. over all, 362 ft. keel, 52 ft. beam and 28 ft. 9 in. deep.

Luncheon was served aboard the vessel to a number of Cleveland vessel men. Harvey D. Goulder, in a brief talk, declared that it was apparent that the steamer embodied in her construction everything making for internal safety, but he felt that there should be correlation of effort to obviate disaster. On one side, he said, are the Lake Carriers' Association and the Great Lakes Protective Association, and on the other side the Dominion Marine Association. With the combined efforts of both governments looking to an absolute observance of the pilot rules, he felt that disasters could practically be eliminated except those that are caused by some superlative condition of the elements such as existed last November.

Protecting Lake Water Supply

Representative Mann, of Chicago, has introduced the following bill in Congress:

That hereafter no common carrier operating vessels, craft, or other vehicles or structures for the purpose of navigation, shall discharge or cause to be discharged sewage or any other noxious material into the waters of the Great Lakes so as to pollute water supplies of cities or towns or of other vessels plying on the Great Lakes.

Sec. 2. That no common carrier operating on the Great Lakes shall provide on steam vessels, for the use of their crews and passengers, water supplies containing organisms or materials liable to cause disease of man.

Sec. 3. That the secretary of the treasury shall have authority to make regulations for the enforcement of this act.

Sec. 4. That when any common carrier, or officer, agent, or employe of any common carrier, shall wilfully violate this act, such common carrier, officer, agent or employe shall be deemed guilty of a misdemeanor and shall, on conviction, be punished by a fine of not more than $500, or imprisonment for not more than two years, or both, in the discretion of the court.

The measure is silent on the subject of pollution from cities which is infinitely greater than that caused by vessels.

The barge Redfern, in tow of the steamer Sawyer loaded with lumber and bound for Tonawanda, took a sheer immediately after leaving the West Neebish Cut, St. Mary's River, and collided with a crib on May 24. She soon filled and sank. The Redfern is owned by the Hines Lumber Co., of Chicago.

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July, 1914

Navigation in Fog

An appalling disaster overtook the Canadian Pacific liner Empress of Ireland in the lower reaches of the St. Lawrence river when she was struck by the collier Storstad and sunk in fourteen minutes. The collier ripped her badly on the port side, opening several compartments, which caused the liner to fill and sink with almost incredible speed. The collision was due to fog, though both steamers were quite aware of each other's presence. There is such a mass of conflicting data that it is impossible to form as yet a reasonable conclusion as to what actually happened. The earlier stories seemed to indicate that the collier was at fault, but later reports fill the mind with certain misgivings concerning the liner's part in it. Nothing can be set down until the board of inquiry meets, except this—that the accident would not have happened if both vessels had got down to bare steerageway and felt their way past each other as the law very plainly directs. Over one thousand lives were lost and the tragedy is all the more pitiful because it was so needless.

On the lakes another steamer has been lost through collision in fog, the W. H. Gilbert, owned by the Lakewood Steamship Co., having been sunk in collision with the steamer Caldera, owned by the Kinney Steamship Co., about 15 miles south of Thunder Bay, Lake Huron. The Gilbert was struck fairly head-on by the Caldera and it is estimated that she sank in five minutes. Fortunately the Caldera was able to hold her bow in the Gilbert's side until the crew of the Gilbert had climbed aboard her. The accident happened shortly after breakfast and all members of the crew were up.

Now this accident never in the world would have happened if both steamers had been proceeding under check and had got down to bare steerageway when they were aware of each other's proximity. The pilot rule on this subject is very clear:

"Every vessel shall, in thick weather, by reason of fog, mist, falling snow, heavy rain storms or other causes, go at moderate speed. A steam vessel hearing, apparently not more than four points from right ahead, the fog signal of another vessel, shall at once reduce her speed to bare steerageway and navigate with caution until the vessels shall have passed each other."

It can be set down as a fixed and certain fact that if a master runs his vessel at full speed through fog he is doing so on his own responsibility and in direct violation of the orders of his owner. There is no owner on the lakes who wants his master to take such a chance. There may be here and there a detached manager whose financial interest in the fleet is small that is indifferent to the subject, but if there is, he will presently cease to be doing business on the lakes. The orders that go out from the leading offices are positive and direct that the pilot rules regarding navigation in fog shall be strictly observed and we repeat that when a master violates the rules he does so in direct opposition to the wishes of his owner.

The curious thing is that some of the masters seem to think that owners are not serious in their instructions in this regard and that the owner is inclined to wink at a violation when it is successfully executed. That certain masters harbor this delusion is proved by the fact that collisions in fog continue to occur. The remedy for that sort of thing is a sharp rebuke when maneuvers are successfully carried out which have a large element of chance in them. Certain owners are careful to see that that sort of navigation is discouraged even when successfully performed.

If a navigator comes through the rivers when 20 or 30 other vessels are lying at anchor by reason of thick weather, it is a foregone conclusion that he has been taking chances. He has assumed a risk which his owner does not want him to take and the thing to do is to put him on the carpet and convince him that that sort of navigation is not desired.

Every master on the lakes has been repeatedly told that the safety of the ship is his first consideration. Now there can be no side-stepping of that order. A master who is shoving his ship along in thick weather is not giving safety first consideration. He is actuated by other motives, very natural, human motives, to make as quick a run as possible, and he hopes thereby to win the approbation of his owner. He has got to get that idea out of his head just as fast as possible. He may get a bump on a single trip sufficient to knock his owner's profits for the entire season. Many vessels on the lakes are carrying their own insurance and more will do so as time goes on. The Great Lakes Protective Association, which is simply an association of vessel owners, is carrying 25 per cent of insurance on its own vessels. Obviously when an accident happens they bear 25 per cent of the loss, which is a considerable proportion for a single company to bear and makes serious inroads into capital account when the loss is a total one. There is absolutely no sense in taking a needless risk and every master should bear uppermost in his mind the fact that he is putting his employer's property in jeopardy when he does so. If every master owned his own vessel and operated it without insurance, he would be mighty careful what he did. That is exactly the point of view the owner desires him to possess and to keep uppermost in his mind at all times.

Lake Trade

The ore movement to June 1 is less than 50 per cent of which it was to June 1 of last year. About 25 per cent of the vessels enrolled in the Lake Carriers' Association have not yet gone into commission. No season in many years has exhibited the lassitude of the present one and no material improvement is looked forward to until July. Up to June 1, 4,121,749 tons of ore were shipped as against 8,150,599 tons for the corresponding period last year, a decrease of 4,028,850 tons. The coal movement has also been slow owing to coal mines. The grain trade is being cared for by the line boats and several bulk freighters have gone into ordinary rather than knock about the harbor for cargoes. There is some reason to believe, however, that the fall months will be brisk.

Following were the ore shipments during May and up to June 1 with corresponding data for last year:

Port.	May, 1913.	May, 1914.
Escanaba	738,158	385,188
Marquette	489,547	121,873
Ashland	681,460	300,928
Superior	2,047,396	1,673,269
Duluth	1,939,848	734,090
Two Harbors	1,387,803	636,715
	7,284,212	3,852,063
1914 decrease		3,432,149

Port.	To June 1, 1913.	To June 1, 1914.
Escanaba	955,187	495,917
Marquette	527,041	121,873
Ashland	734,941	341,766
Superior	2,300,271	1,735,607
Duluth	2,100,220	734,090
Two Harbors	1,532,939	692,496
	8,150,599	4,121,749
1914 decrease		4,028,850

Lake Erie Ore Receipis

Out of a total movement of 3,852,063 tons of ore during May, 2,589,338 tons were received at Lake Erie ports, distributed as follows:

Port	May, 1913
Buffalo	325,671
Port Colborne	43,543
Erie	30,230
Conneaut	591,331
Ashtabula	504,495
Fairport	216,632
Cleveland	479,736
Lorain	193,074
Huron	92,346
Sandusky	——
Toledo	78,096
Detroit	34,184
Total	2,589,338

Commerce of Lake Superior

The commerce passing through the canals at Sault Ste. Marie during May amounted to 7,488,116 tons, a decrease of 3,888,079 tons from the corresponding movement for May, 1913. The movement to June 1 was 8,262,635 net tons, as against 13,281,750 net tons to June 1, 1913, a decrease of 5,019,115 tons. Following is the summary:

EAST BOUND.	To June 1, 1913.	To June 1, 1914.
Copper, net tons	18,910	9,169
Grain, bushels	22,193,810	18,381,894
Bldg. stone, net tons	....	....
Flour, barrels	1,588,511	1,475,252
Iron ore, net tons	7,308,544	3,765,607
Pig iron, net tons	3,759	4,328
Lumber, M. ft. B. M.	77,984	72,227
Wheat, bushels	42,059,027	34,905,559
Unclass. frght., net tons	60,340	53,996
Passengers, number	1,684	939
WEST BOUND.		
Coal, anthracite, net tons	626,159	287,938
Coal, bituminous, net tons	2,890,789	2,192,001
Flour, barrels	....	367
Grain, bushels	....	....
Mfctd. iron, net tons	85,789	66,726
Salt, barrels	181,095	266,133
Unclass. frght., net tons	121,615	171,092
Passengers, number	1,829	1,120
SUMMARY OF TOTAL MOVEMENT.		
East bound, net tons	9,430,301	5,505,160
West bound, net tons	3,851,449	2,757,476
Total	13,281,750	8,262,636
Vessel passages	3,767	2,990
Net registered tonnage	9,703,397	6,347,431

May Lake Levels

The United States lake survey reports the stages of the great lakes for the month of May, 1914, as follows:

Lakes.	Feet above mean sea level.
Superior	602.33
Michigan-Huron	580.32
Erie	572.91
Ontario	246.95

Lake Superior is 0.50 ft. higher than last month, 0.26 ft. higher than a year ago, 0.36 ft. above the average stage of May of the last 10 years, 0.72 ft. below the high stage of May, 1861, and 1.51 ft. above the low stage of May, 1911. Average stages of the last 10 years indicate that the June level will be 0.3 ft. higher.

Lakes Michigan-Huron are 0.26 ft. higher than last month, 0.74 ft. lower than a year ago, 0.46 ft. below the average stage of May of the last 10 years, 3.20 ft. below the high stage of May, 1886, and 0.76 ft. above the low stage of May, 1896. Average stages of the last 10 years indicate that the June level will be 0.3 ft. higher.

Lake Erie is 0.81 ft. higher than last month, 1.07 ft. lower than a year ago, 0.06 ft. above the average stage of May of the last 10 years, 1.51 ft. below the high stage of May, 1862, 1.60 ft. above the low stage of May, 1901. Average stages of the last 10 years indicate that the June level will be 0.2 ft. higher.

Lake Ontario is 0.20 ft. higher than last month, 1.02 ft. lower than a year ago, 0.02 ft. below the average stage of May of the last 10 years, 2 ft. below the high stage of May, 1870, and 1.99 ft. above the low stage ot May, 1872. Average stages of the last 10 years indicate that the June level will be 0.2 ft. higher.

Cape Cod Canal Tolls

It is announced that vessels of above 500 gross tons will be charged for passage through the Cape Cod canal on the basis of having on board 800 tons of cargo at 7 cents per cargo ton per single passage. Vessels having on board more than 800 tons, 7 cents per cargo ton; and vessels of more than 500 gross tons without cargo will be charged 5 cents per gross ton. These rates were fixed recently by the Boston, Cape Cod & New York Canal Co., which is building this waterway at a cost of $12,000,000.

Personals

R. B. Wallace has resigned as general manager of the American Ship Building Co., which office he has held since 1908.

Capt. W. C. Richardson, of Cleveland, celebrated his seventy-fourth birthday anniversary on June 10, and the trade hopes he will round out the century.

J. H. Sheadle, who for many years has held the title of secretary of the Cleveland-Cliffs Iron Co., was elected vice president of that company at a recent meeting of the board of directors. S. Livingston Mather was elected secretary. During the past 15 years the operations of the Cleveland-Cliffs Co. have undergone an enormous expansion and Mr. Sheadle's activities have covered a very wide range in the affairs of this organization.

Contracts have been arranged for the construction of the two colliers which have been chartered by the Dominion Coal Co., Sydney, Cape Breton, for a period of ten years. One of the contracts has been placed by James Chambers & Co., Liverpool, with Short Brothers, Sunderland; and the other by John Heron & Co., Liverpool, with Doxford & Sons, Sunderland.

The vessels will each have a deadweight carrying capacity of 11,000 tons, and they are specially designed to suit the Dominion Coal Co.'s requirements. They are to be of the single-decked type, with topside tanks, and are to be built on the Isherwood system of ship construction. They will be the largest single-decked steamers flying the English flag.

The tug Wisconsin was launched at the Cleveland yard of the Great Lakes Towing Co. on May 23. She is intended to work in ice in Duluth harbor.

Marine Turbines

The Westinghouse Turbine and Reduction Gear Propelling Machinery for the Collier Neptune

WITH the introduction of gears between the turbine and propeller, a number of problems arise which were not met with in the direct arrangement. The use of gears permits the turbine to run at almost any desired number of revolutions and thus materially reduces the size and weight of the turbine for any given capacity.

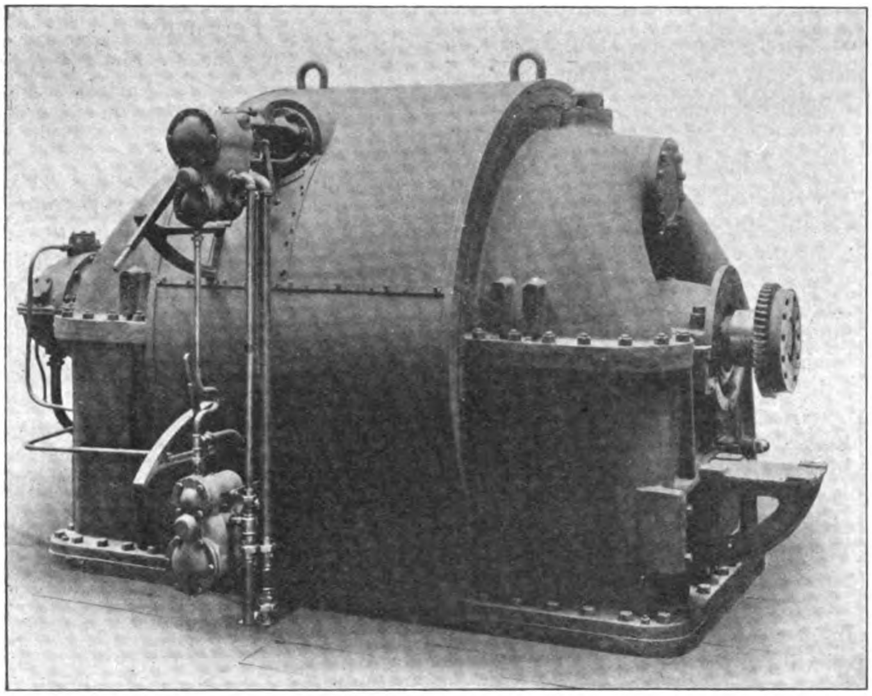


FIG. 1—PORT TURBINE LOOKING FORWARD, SHOWING GOVERNOR AND OIL RELAY CYLINDERS

With the direct connected arrangement, owing to the increase in weight and particularly the length of the turbine, it has been difficult to obtain a sufficiently large proportion of the ahead power in the astern turbine. In many cases where sufficient astern power was available, the small diameter of the propeller made this power of little benefit because the thrust in reversing rose to such a point that cavitation occurred and the propeller became ineffective.

With the geared installation, however, owing to the lower speed, the propeller can be made of such ample area that its efficiency, when reversing, is very much higher than that of a direct connected one. As a result of this higher propeller efficiency in the geared unit, a smaller proportion of the ahead power gives far better maneuvering qualities than a larger proportion of the ahead power gives in a direct connected installation.

This condition is rather fortunate for two reasons:

First—With the increased speed of the geared turbine, its economy is much higher than that of the direct connected unit. Due to this lower water rate of the ahead turbine, it necessarily follows that the astern turbine (in order to develop a given percentage of power of the ahead on the same weight of steam and same steam conditions) must be designed to give practically as good a water rate as that of the ahead turbine in a direct connected installation. Therefore, to develop the same percentage of the ahead power, the astern turbine in a geared installation must be proportionately larger than in the direct connected unit.

Second—As the size and the speed of the turbine increases, the power absorbed in running the astern turbine idle increases very rapidly, so that the greater the proportion of the ahead power it is desired to develop when running astern, the more difficult it becomes to make the ahead turbine as economical as desired.

As the power required to drive the astern turbine idle increases with the density of the stream in which it is rotating, it is obvious that it is more essential to maintain a high vacuum in a geared than in a direct connected installation; and the higher the vacuum which can be maintained at all times, the greater the proportion of the ahead power which it is permissible to develop when running astern. Likewise, if the astern turbine is designed

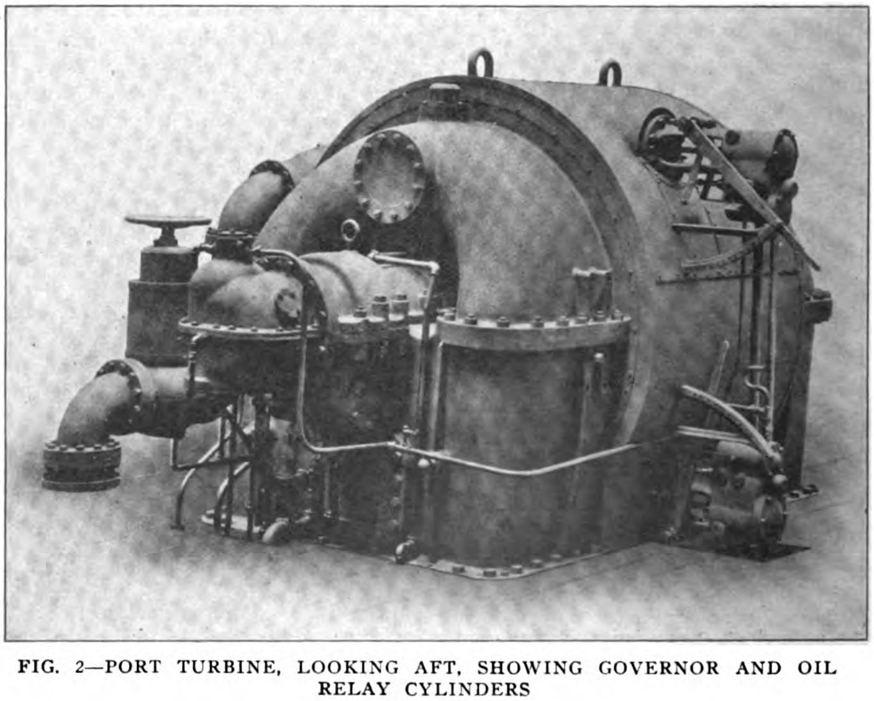
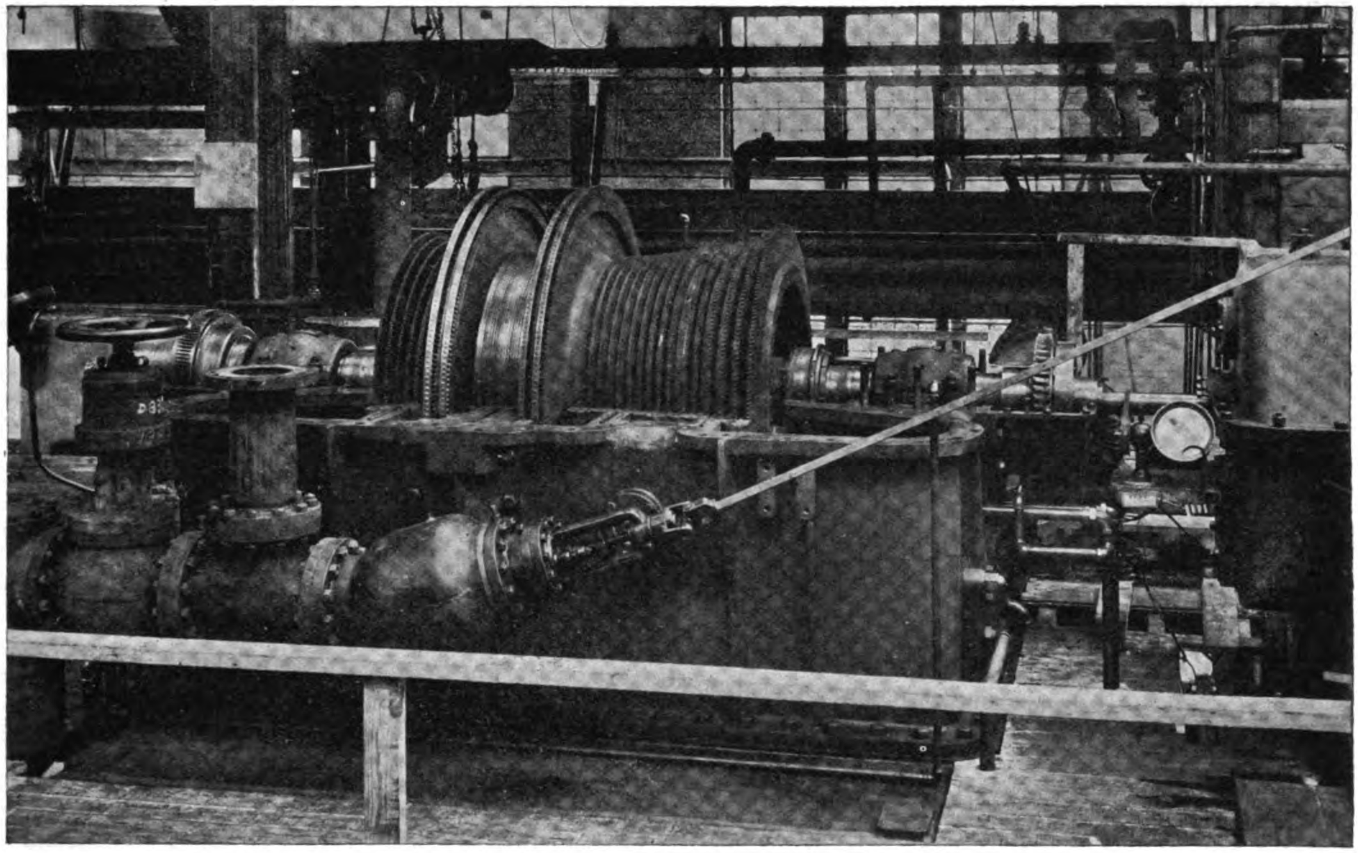


FIG. 2—PORT TURBINE, LOOKING AFT, SHOWING GOVERNOR AND OIL RELAY CYLINDERS



TURBINE ON TEST STAND—CYLINDER BLADE RINGS REMOVED

to develop too great a proportion of the ahead power, the turbine becomes too long, with the attendant difficulties which this length involves.

Fortunately, however, in a geared turbine installation it is not necessary to develop more than 40 to 45 per cent of full power ahead when running astern, since the starting and stopping torque available for bringing the turbine to rest, reaches a maximum value of from three to four

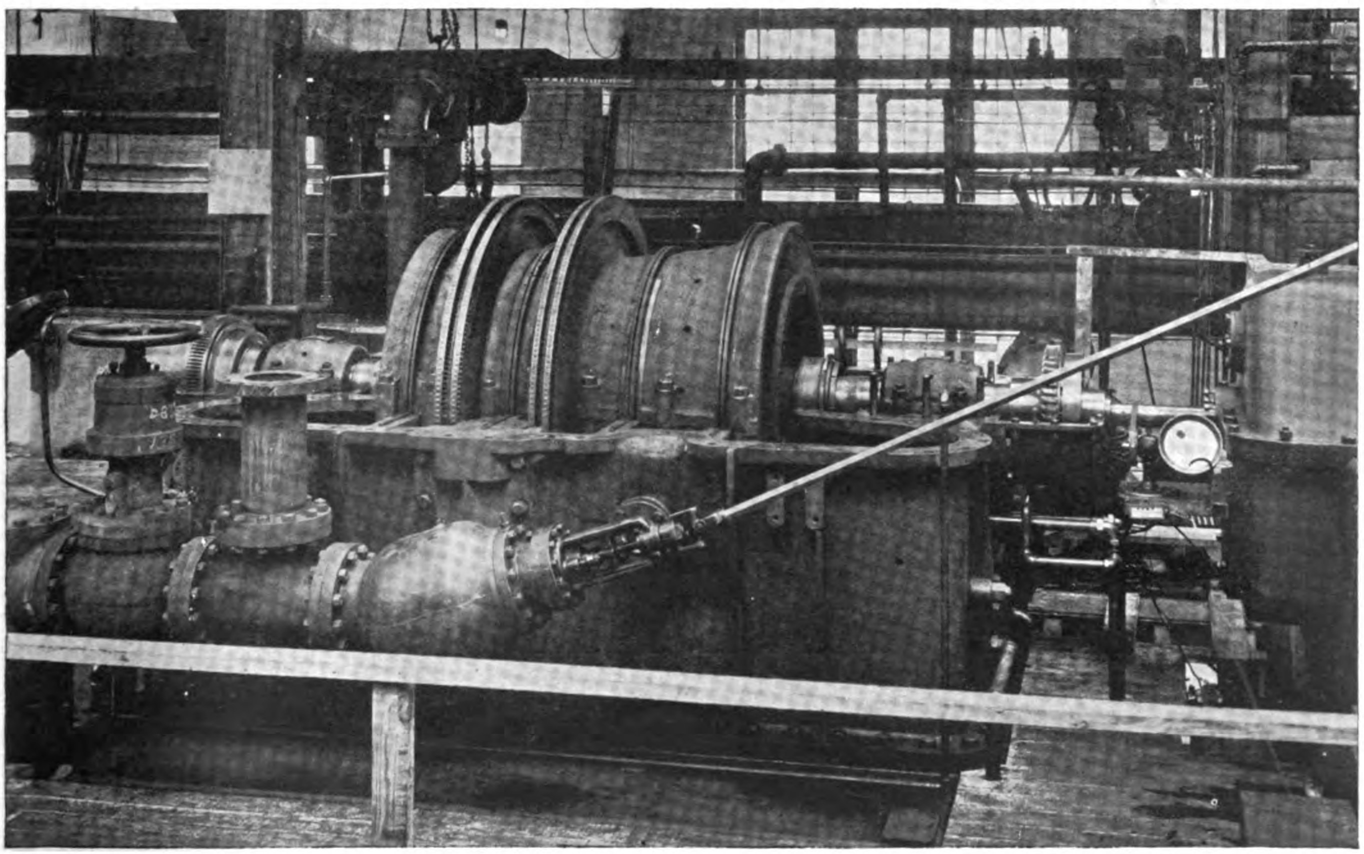


FIG. 3—TURBINE ON TEST STAND—CYLINDER BLADE RINGS IN PLACE

times the ahead full load torque. It will be obvious, therefore, that a turbine capable of developing 40 per cent of the full power ahead, actually has a starting and stopping torque greater than the full load torque ahead. The maximum torque which a reciprocating engine can develop is equal to the area of the pistons into the mean effective pressure with cut-off at full stroke. Therefore, the turbine can be brought to rest and reversed more rapidly than the reciprocating engine. As the propeller speed in the geared turbine installation is about the same as that which would be used in a reciprocating engine vessel, the maneuvering qualities of a turbine with 40 to 45 per cent of the ahead power would be somewhat better than that of the reciprocating engine.

Advocates of the reciprocating engine may raise an objection at this point by calling attention to the fact that the energy stored in the turbine rotor and gear wheel exceeds that stored in the reciprocating parts of an engine. Though this is true, it is fortunate that the greater stopping torque of the turbine is sufficient to more than offset the greater stored energy.

The turbine has further the advantage that the torque at very low speeds is sufficient to revolve the propeller against its greatly increased resistance to turning at the instant of reversing when the water flowing past it (due to the motion of the ship) tends to keep it revolving, since the propeller then becomes a water turbine in effect, and it requires a prime mover with the characteristics of a turbine to overcome the greatly increased torque.

When running at full power, the links of a reciprocating engine may be thrown over as rapidly as the steam can be shut off from the ahead and on the astern turbine, but even when the links have been thrown over, the engine does not respond immediately, but first stalls, until the drag of the propeller and resistance of the hull have checked the velocity to the point where the engine can overcome the resistance of the propeller. In the turbine installation, however, the propeller begins to revolve in the opposite direction as soon as it has come to rest, so that even if the time required to bring the propeller to rest were the same, the turbine would still have a considerable advantage.

In general, an engineer would not dare to throw the links hard over, with full steam on, except in a very slow speed vessel of comparatively low power.

What has just been said regarding the effect of increase of power of the astern turbine on the economy of the ahead turbine, applies more particularly to a complete reaction turbine. Most of these disadvantages are obviated in the design adopted by the Westinghouse Machine Co. by the substitution of an impulse wheel for the high pressure portion of both the ahead and astern turbines.

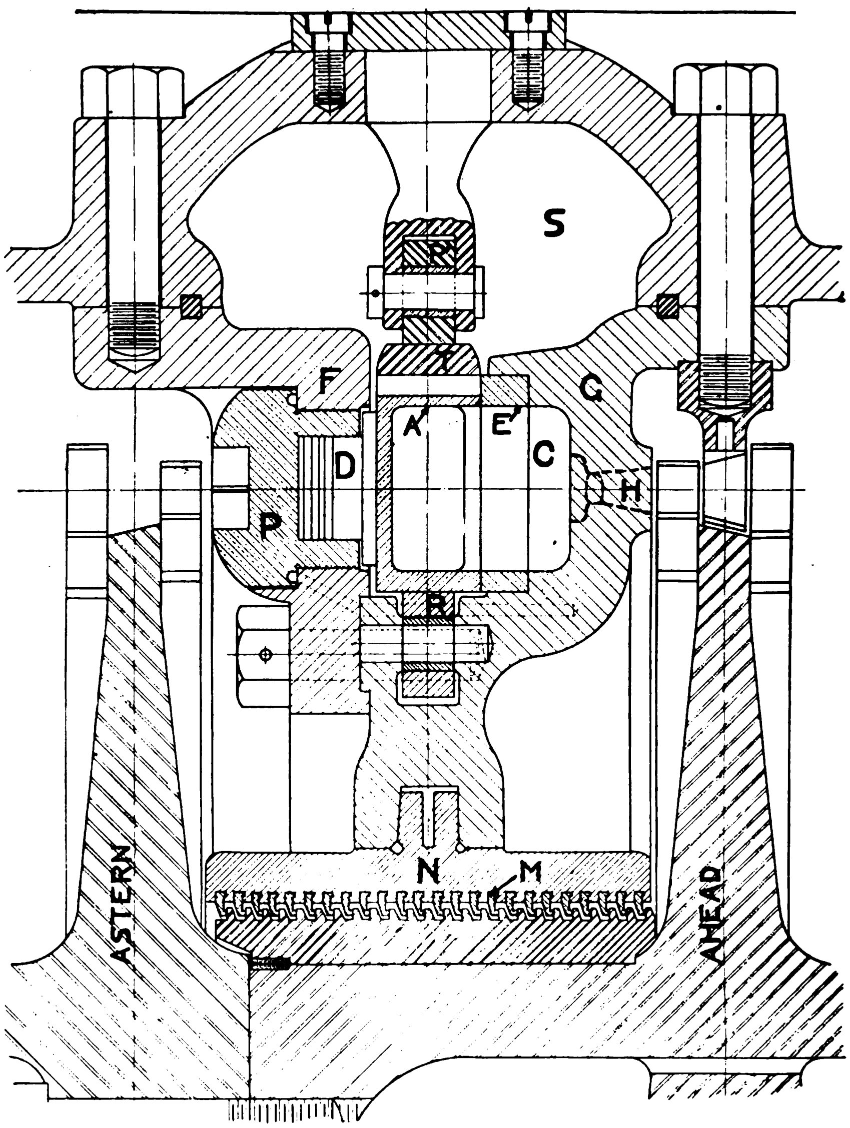


FIG. 5

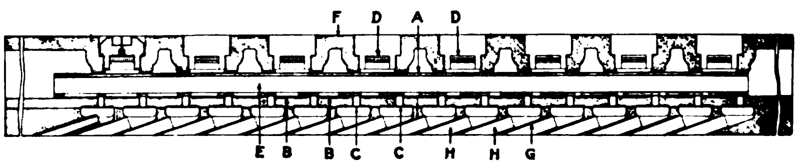


FIG. 4

The Westinghouse Machine Co. has used from 60 to 70 per cent of the full power ahead for the normal astern power where, in the opinion of the purchaser, it is deemed desirable, and in the case of Neptune approximately 90 per cent of normal ahead power has been developed by the astern turbines. However, regardless of the normal astern power for which the turbine is designed, a greater proportion of the ahead power may be developed by using more steam, which as a rule, is available since the astern turbine is only in use at intervals.

The use of the high pressure impulse wheel instead of reaction blading in marine turbines, has two important purposes. First, it has a greater stopping torque, and second,

permits the use of nozzle control.

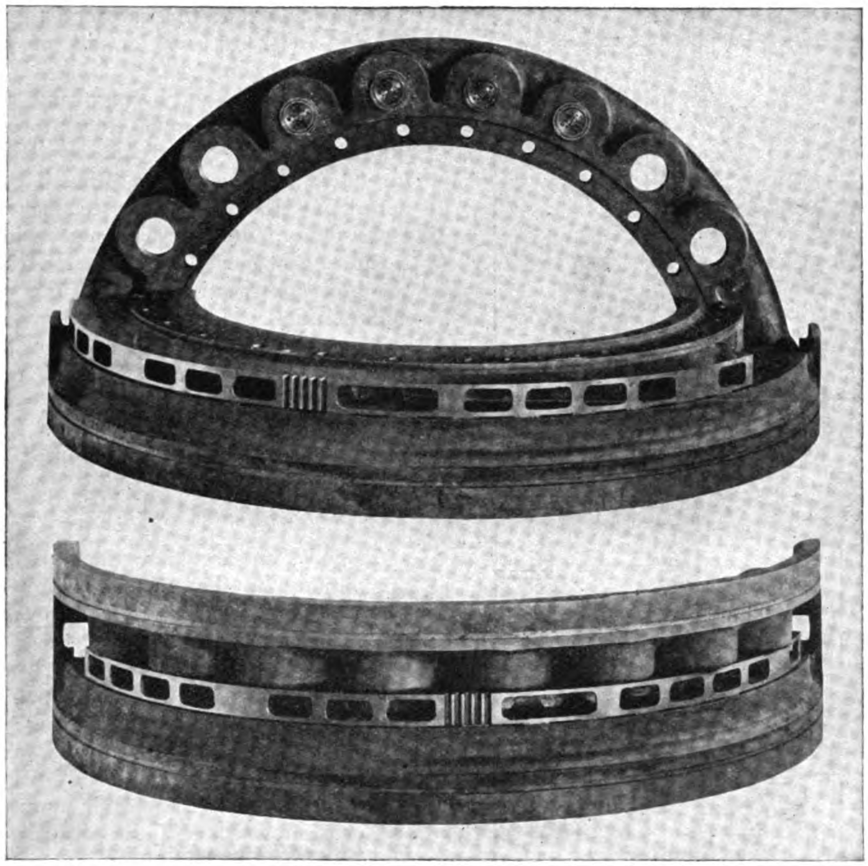
The use of the impulse wheel, furthermore, materially shortens the ahead and astern turbines, thus making a more compact and lighter installation, and at the same time eliminating the short high pressure reaction blades so that only a comparatively few rows of large substantial blades are required.

The use of the combination impulse reaction turbine has the advantage that complete ahead and astern turbines of high economy can be contained in a common cylinder, thus obviating, except under some unusual condition, the necessity of employing the cross-compound arrangement of turbines. Each turbine, whether two or more turbines are used to drive a common gear or independent gears, is a complete unit in itself and may be operated independently of other turbines. In twin or triple screw vessels, each engine room is thus complete in itself without any cross-connections and the attendant complication required to permit operating either high or low pressure turbine when either one or the other is out of commission.

The combination turbine using the impulse and reaction elements, has a decided advantage over the pure reaction or pure impulse type of turbine, since, as previously mentioned, it obviates the short, frail blades of the high pressure section of the pure reaction turbine and obviates the troublesome diaphragms and interstage packings of the pure impulse turbine.

Though the impulse wheel is not as efficient as reaction blading, the advantages which result from its use are so important where high blade speeds can be employed that its use is amply justified.

It is possible to so design an impulse wheel with two rows of blades that its efficiency will not fall off seriously when the steam velocity is only two to two and a half times the blade speed, and will remain nearly constant until the velocity of the steam reaches four to four and one-half times the blade speed.



FIGS. 6 AND 7

Thus by the use of nozzle control, the efficiency of the high pressure portion of the turbine can be kept nearly constant over a considerable range of power and speed.

If we assume an initial condition of 200 lbs. steam pressure and 550 ft. per second blade speed for the impulse wheel, the steam velocity at full power may be as low as 1,200 ft. per second, corresponding to a heat drop of 32 b. t. u. and expansion from 200 lbs. absolute to 135 lbs. absolute.

If we consider the power to vary as the cube of the revolutions per minute, then at 37.5 per cent of full power, the revolutions would be 72 per cent of those corresponding to full power, and if we further assume that it requires 40 per cent of full power steam to develop 37.5 per cent of full power at the reduced revolutions, the absolute pressure at the inlet to the reaction blading (which is directly proportional to the flow of steam), would be 40 per cent of 135, or 54 lbs. absolute.

In expanding from 200 lbs. absolute to 54 lbs. absolute, 92 b. t. u. would become available, which, allowing for the nozzle efficiency, would correspond to a steam velocity of approximately 2,140 feet per second, and since this is but five and four-tenths times the reduced blade speed, the falling off in economy of the impulse wheel would be but very slight.

It will be evident, however, that if the impulse blade speed is low, as in the case of some direct connected turbine installations, since the b. t. u. drop which can be efficiently provided for in the impulse wheel is very small (generally less than one-fourth of those used in the above illustration), a comparatively small decrease in power, and consequent increase in heat drop in the impulse wheel, very seriously decreases the efficiency.

Special Cruising Turbine Unnecessary

With the impulse wheel, blade speeds possible in a Westinghouse geared installation, such a large range of heat drop can be efficiently employed, that economies only approached at full power in the past, are possible at cruising speeds and special cruising turbines are entirely unnecessary.

A difficulty which arises in the pure impulse marine turbine when designed for high speed in connection with reduction gearing, is that in order to avoid excessive length it is difficult to obtain hubs of sufficient length between the wheels of the various stages to entirely eliminate the danger of distortion of the discs and hubs by gyroscopic action of the discs at high speed. In connection with direct connected turbines, this has frequently been a subject of discussion, but owing to the fact that the bending moment set up in the shaft by the gyroscopic action of one disc neutralizes that set up by the adjacent discs, this has been considered of little importance, but the possibility of side swiping of the blades due to stretching of the hubs from this cause, has been entirely overlooked.

From the following illustrations and

description, the reader will be able to judge for himself how completely the various objections referred to have been avoided in the design of the Westinghouse marine turbine, of which one form only is hereinafter described, a number of suitable arrangements being available for the several different classes and conditions of service.

Fig. 4 is a cross section on the center line of the ahead high pressure nozzles, showing the nozzle valve and balancing pistons, and Fig. 5 is a partial longitudinal section through the turbine showing the nozzle valve and nozzles. The valve *A* is made of monel metal, the valve seat *E* of cast iron and the balancing pistons *D* and retaining caps *P* are all made of bronze.

The nozzle valve proper *A*, as previously mentioned, is moved by a rack which engages with gear teeth cut in the periphery *T* of the valve, by means of which it can be partially rotated.

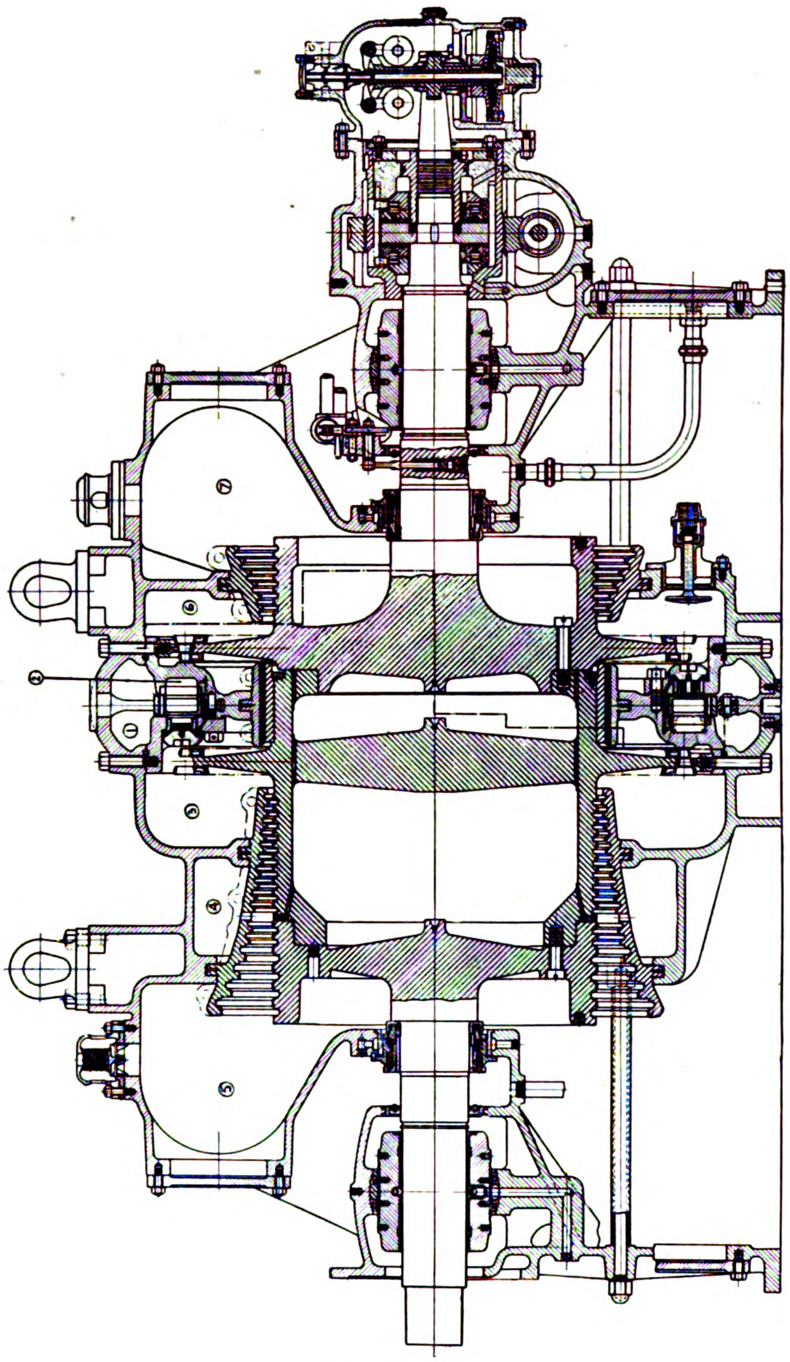


FIG. 8

To permit the movement of the valve with the least possible force, the valve is supported upon internal and external rollers *R* and *R'*.

The pressure of the steam on the valves is balanced by means of small pistons *D*, of which there is one for each pair of nozzles, there being 12 nozzles in the ahead and 16 nozzles in the astern. The space between the balancing pistons *D* and the retaining plugs *P* is connected to the space *C* of the second nozzle in each group of two, thus at any instant the unbalanced steam pressure can only be equal to the area of one of the ports in the valve *E*, admitting steam to the space *C*.

As will be readily seen from the developed cross section of the nozzle valves the ports *BB* in the valve *A* and the ports in the valve seat *E* are so arranged that as the valve is moved to the left, the ports in *E* communicating with the nozzles are opened in succession, thus maintaining the full boiler pressure at the entrance to the nozzles, whether one or all of the nozzles are open.

In order to avoid leakage and distortion, the nozzle valve *A* is of rectangular section, cored out as shown in the developed section, Fig. 4, thus permitting the valve face to make a steam-tight joint at each port which is not open, while at the same time the box construction ensures the circumferential rigidity necessary.

The main steam supply for the ahead opens into the space *S*, Fig. 5, in the lower half of the turbine cylinder. Leakage from the space *S* into the turbine cylinder is prevented by dowel rings as shown.

Dummy Strips

As will appear later, there is but one dummy in the turbine, which divides the high pressure ahead from the astern turbine. This is shown in detail in Fig. 5. The dummy cylinder ring is a separate casting, which is supported from the nozzle ring *G*. The dummy strips are of the standard type employed in all Westinghouse turbines, and are 24 in number.

Fig. 6 shows one of the ahead nozzle blocks and sliding valve partly assembled, and also four of the balance pistons in place. Fig. 7 shows an ahead nozzle block, slide valve and balance pistons completely assembled ready to put in the turbine casing.

A cross sectional elevation of the completely assembled turbine is shown in Fig. 8. It will be noted that the turbine spindle is made in three parts, these being steel castings, one of which forms the forward spindle end and astern impulse wheel and reaction drum. The middle section of the spindle forms the ahead impulse wheel and part of the ahead reaction drum, the remaining part of the reaction drum and after spindle end being formed in a separate piece. The various parts of the spindle are bolted together. This spindle con-

struction is unusually rugged and heavy for marine work, but it is partly necessitated by the comparatively high blade speed of the impulse wheels, which is 525 ft. a second at full power. As the effective mean diameter of the ahead and astern reaction sections of the turbine are the

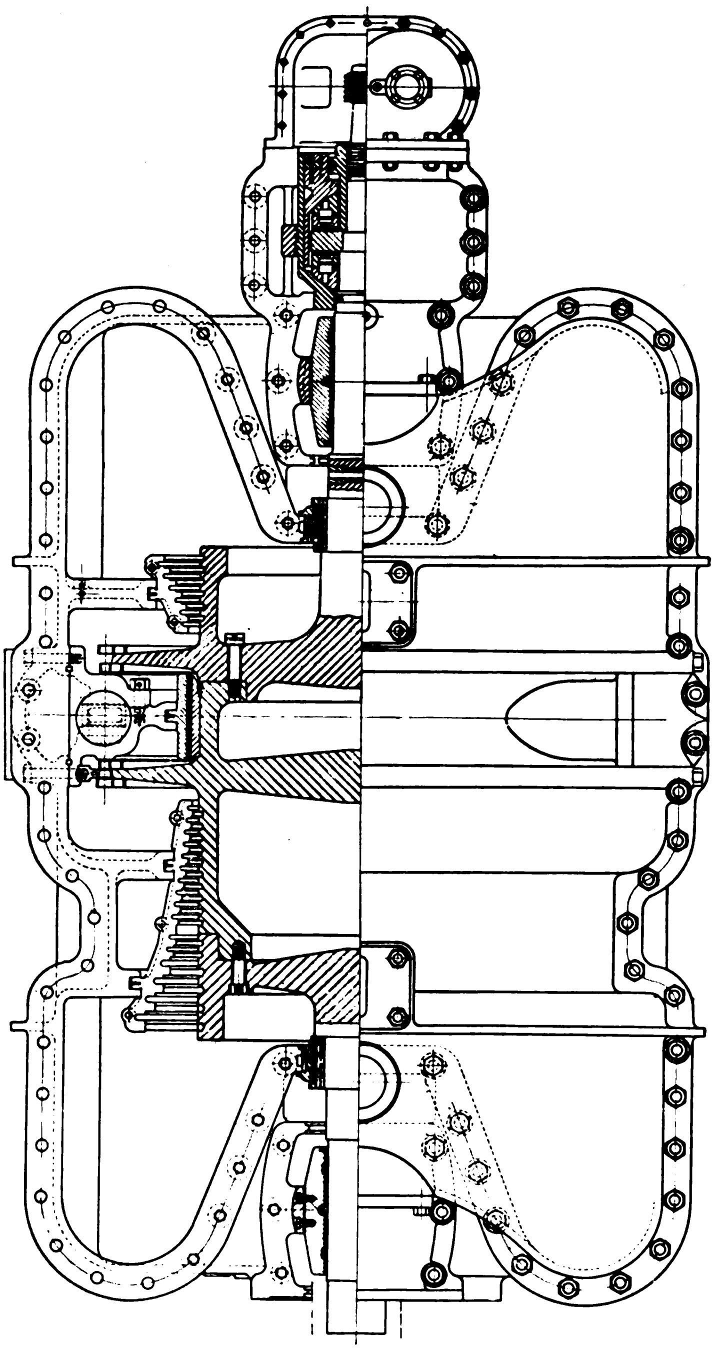


FIG. 9

same, a single dummy located between the two impulse wheels serves for both the ahead and astern reaction sections. However, any slight unbalanced end thrust which may arise in either the fore or aft direction, is amply taken up by a Kingsbury thrust bearing, which is clearly shown in the longitudinal cross section. It will be recalled that the Kingsbury thrust bearing consists of a number of independent babbitted shoes, each supported on a spherical seat formed in a ring, which itself is spherically seated in the bearing housing, thus permitting each shoe to adjust itself independently so as to obtain a uniform bearing pressure over its entire surface, and the spherical seating of the shoe supporting ring permits the individual shoes to distribute the load equally among each other. A single collar on the shaft thus serves in place of the numerous collars used in the older type of thrust adjusting bearing.

The turbine bearings are of the standard Westinghouse spherical seated type, with loose keys and shims, permitting centering the turbine spindle without the necessity of rebabbitting and boring the bearings exactly concentric with the bearing housing.

The turbine glands are a modified type of labyrinth packing, as shown in Fig. 10, consisting of a brass sleeve *A* on the shaft, in which a snap ring *B* fits and packs the sleeve *C*. The sleeve *C*, which is made in halves, is held together by the rings *DD*, which are screwed on tapered threads. The sleeve *C* fits snugly, but not tight, on the sleeve *A* and rotates with the shaft, but end movement of the sleeve *C* relative to the shaft is permitted so that the collars of the sleeve *C*, which fit in the bushing *E* with a few thousandths clearance, will not bind or press too heavily against the bush *E* when the spindle moves endwise from expansion or in taking up the slight end motion of the spindle in the thrust adjustment bearing. A feather key *G* partly recessed in the sleeve *A* and partly in sleeve *C*, drives the latter with the turbine shaft.

Stationary Reaction Blades

The bushing *E* is screwed into a second bushing, as shown, thus permitting the whole stuffing box to be removed from the turbine without removing the turbine cover. Steam for sealing and lubricating the labyrinth is supplied through the inlet *I*.

The stationary reaction blades instead of being held in the turbine cylinder proper, as is customary in marine turbines, are held in loose cast steel rings, which are doweled in the turbine cylinder so that they can be easily removed. This obviously permits the carrying of spare rings, bladed ready for use, thus facilitating rapid repairs in the event of damage to either the ahead or astern reaction blading. The loose reaction blade rings are clearly shown in Fig. 3, which shows the starboard turbine on the test floor with the upper half of the turbine casing removed. The frontispiece shows the upper half of the reaction cylinder blade rings removed, exposing the spindle to view.

The auxiliary steam inlet to the ahead reaction blading connects into the space *4*, Fig. 8, and through the holes shown in the reaction cylinder blade rings to the low pressure ahead blading. The pressure at the point of admission of the auxiliary exhaust is about 16 lbs. absolute at full power.

The valve shown, connecting the astern impulse wheel chamber with the condenser, is provided to permit

the escape of any steam leaking past the dummy when running ahead without the necessity of its passing through the astern reaction blading, and thus causing additional lost work.

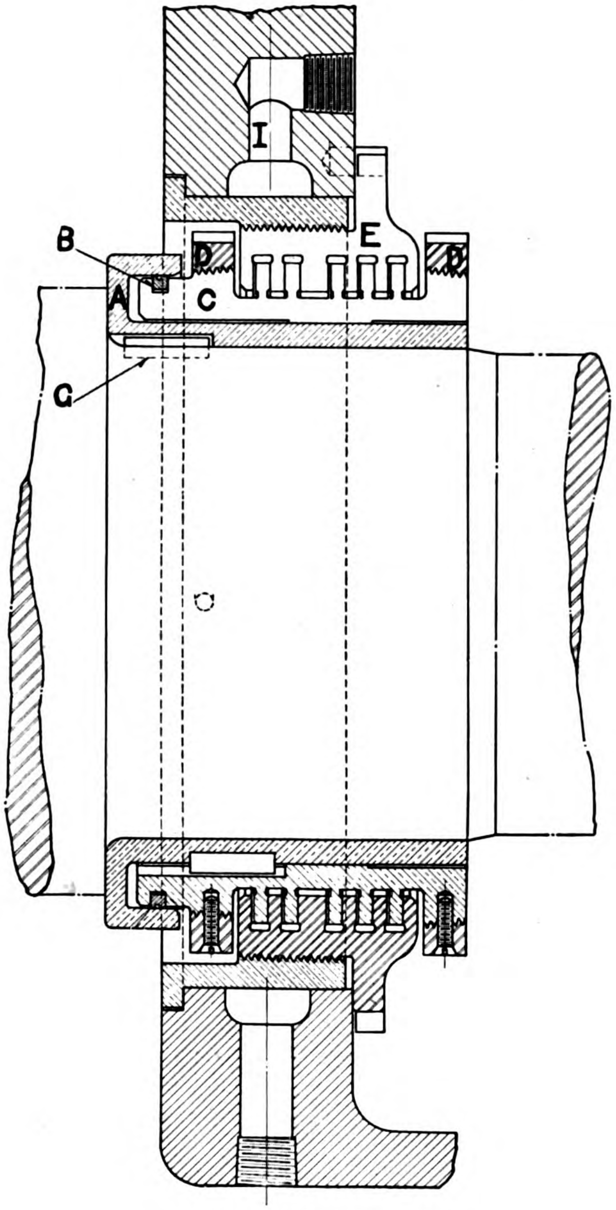


FIG. 10

This is one of the decided advantages of the impulse wheel when used in this manner, as the steam leaking by the dummy cannot cause any additional resistance in the astern impulse wheel when the turbine is running ahead. By-passing the reaction blading obviates any loss at this point. This by-passing valve is operated automatically by a piston resisted by the spring, which normally holds the valve in an open position, as shown, but as soon as steam is admitted to the first astern nozzle, the pressure back of the piston brings the valve to its seat.

An automatic stop of the usual type fitted on all Westinghouse turbines, is provided. The automatic stop plunger in the spindle trips a valve which releases the steam pressure under the piston of the automatic stop valve in the main steam line, the automatic stop valve being placed ahead of the control valve so that it serves for both ahead and astern operation.

Fig. 9 is a semi-plan view and longitudinal section of the turbine.

Fig. 11 shows the method employed to hold the impulse blades. As will be seen from the illustration, slots are cut in the narrow rim on each side of the impulse disc and T-headed shanks on the blades are fitted in these slots, the blades thus being literally hung on a cantilever projecting from the impulse wheel disc. A groove is turned in each side of the projecting cantilevers, in which caulking pieces are inserted, one of these being dovetail and the other flat. The purpose of these is solely to hold the blades from moving sidewise in the slots. This construction permits making the blade attachment as strong as the cross section of the blade itself, and at the same time reduces the weight of the rim supporting the blades to a minimum and simplifies the distribution of stresses at the rim materially. There is no change from hoop stress to disc stress as the slots eliminate the tangential stress ordinarily existing in the rim.

In the past two years an entirely new method of blade attachment has been developed by the Westinghouse Machine Co., in which all dependence upon the frictional grip on the blades is eliminated. This new blade attachment is illustrated in 12, 13 and 14. Fig. 13 is a cross section of a model, which shows the undercut groove and a second smaller groove at the bottom of the primary groove, in which the upset ends of the blades fit.

Gradual Taper

As will be noted in Fig. 14, the ends of the blades are thickened by upsetting on a gradual taper extending from one to three or four inches from the root of the blade, the actual section of the blade being increased about 50 per cent at the root, and at the same time a lip is formed which hooks under the dovetailed shape packing pieces shown. In the smaller blade sections the packing pieces are slipped in by turning them sidewise in the groove until all the blades have been inserted except one or two where the undercut in the turbine

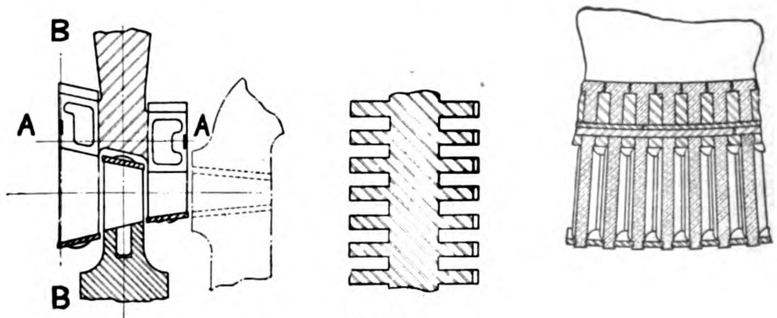


FIG. 11

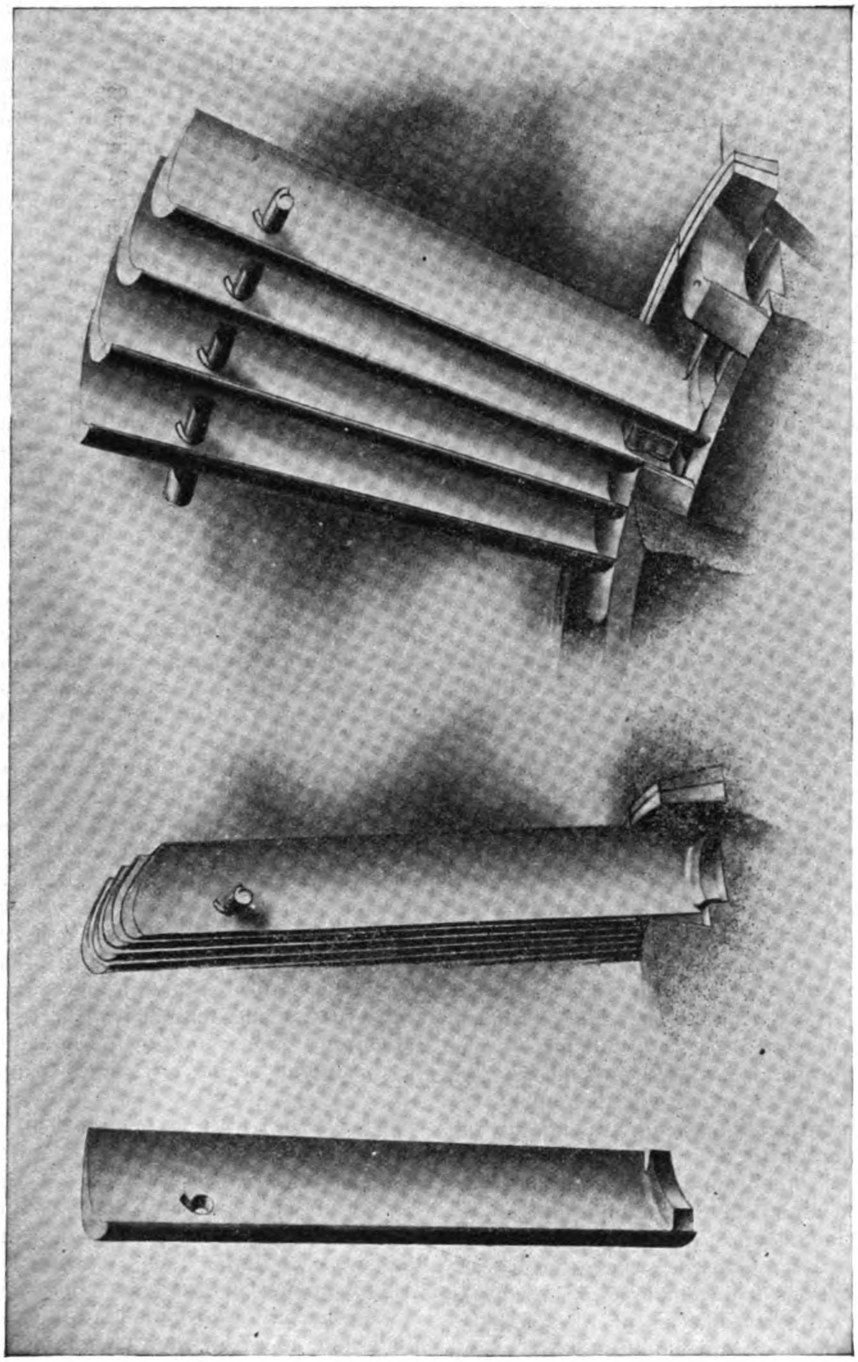


FIG. 12

cylinder blade ring or spindle is removed to permit inserting the last one or two packing pieces, the space cut out of the dovetail for this purpose being finally filled with a soft caulking piece.

In the case of the very largest blades where it is undesirable to remove part of the undercut of the spindle groove, the blades are held in place with double wedges, as shown in Fig. 12. The same form of comma lashing wire, which has been so successfully employed by the Westinghouse Machine Co., has been retained in marine turbines.

The upsetting of the ends of the blades and tapering of the normal section towards the tip of the blades, very materially increases the resistance of the blades to bending stresses, and also to those very serious stresses arising from vibration, and whereas in all other forms of reaction blading attachments the weakest section of the blade is where it meets the cylinder or spindle, this is the strongest point of the blade in the Westinghouse design. This is very clearly shown by the fact that when the lip, Fig. 14, is gripped in a vise and the end of the blade subjected to a bending pressure, the first indication of

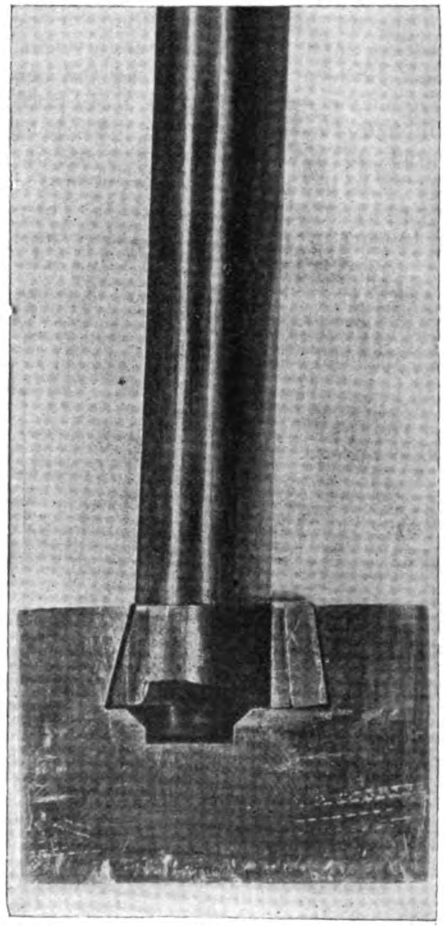


FIG. 13

any bending whatever occurs some two or three inches from the lip in long blades, and, of course, at a somewhat shorter distance from the lip in very small blades. The result of this method of blading is that even most serious rubs between the blades

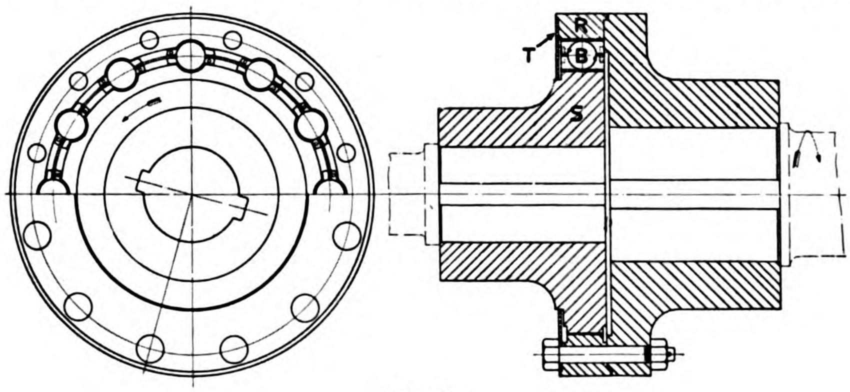


FIG. 15

and stationary portion may be encountered without any damage to the blades other than burring of the ends.

In order to permit the gear pinion to float longitudinally without imposing any end thrust on the teeth of the pinion or gear, a special flexible coupling was designed by Mr. Westinghouse, which is illustrated in Fig. 15. As will be seen, the coupling consists simply of two flanged collars, one on the turbine and one on the pinion drive shaft, and a ring *R* bolted to the portion of the coupling on the turbine shaft. There is a slight clearance between the ring *R* and the hub *S*, and the driving force is transmitted through the ring *R* to the hub *S* by means of steel balls *B*, which are inserted in holes drilled partly in the ring *R* and partly in the hub *S*. These holes are lined with hardened steel

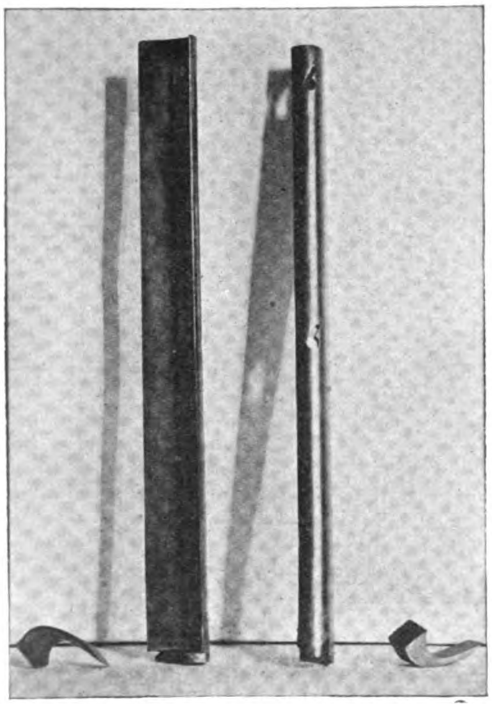


FIG. 14

bushings made in halves, and the balls are retained from coming out of the hole by means of the retaining ring *T*. As will be seen, this coupling is extremely simple and facilitates taking the turbine spindle or pinion out without disturbing any other part. After extended service, it has proven itself entirely satisfactory for this work.

Steel Tug Maycliff

The new steel tug Maycliff, designed by Cox & Stevens, for the Undercliff Terminal & Warehouse Co., of New York and Edgewater, N. J., made a successful trial trip up the East river recently. The vessel was contracted for originally with John H. Dialogue, of Camden, N. J., but completed by the Staten Island Shipbuilding Co. at Port Richmond, N. Y. She is 110 ft. long, 27½ ft. beam and draws 13½ ft. of water. Her engine is of the fore and aft compound type, with cylinders 19 and 42 in. in diameter with 30 in. stroke of piston, and indicates over 800 H. P. There is a spacious salon in the after part of her steel deckhouse capable of accommodating about 50 guests. Her equipment includes a steam steerer, a Kahnweiler steel lifeboat, a Shipmate range furnished by the Stamford Foundry Co., Stamford, Conn., and a Ritchie patent compass from E. S. Ritchie & Sons, of Brookline, Mass. She is lighted by electricity furnished by a General Electric Co. dynamo.

Panama Canal Pilots

The following arrangement has been approved in connection with the handling of applications for the position of canal pilots:

The Washington office of the Panama canal will handle all applications for the position of canal pilot from the region of the Great Lakes, obtain as much necessary information in regard to their qualifications as practicable, arrange an eligible list in the order of merit and submit it, through the governor, to the superintendent of transportation on the Isthmus, accompanied by the full file of the applicant, to be returned later. The Washington office will then make the appointments, when notified by the governor to do so.

All other applications will be handled direct on the Isthmus by the superintendent of transportation. There are already on file a great many applications from employes on the Isthmus, from officers of the Panama Railroad Steamship Line, and from officers of other vessels running to Isthmian ports, most of whom the superintendent has examined in person. The result is that ample material has been found for the complement of pilots that will be necessary for the opening of the canal. In view of the large number of applications already received, and of the fact that they are still coming in, it is believed that there will be no difficulty in increasing the complement of pilots as the trade of the canal warrants.

No applicant is considered eligible for examination unless he holds a master's license for the Great Lakes or ocean going vessels of unlimited tonnage; he must be under 45 years of age, and an American citizen.

Canal pilots will be required to wear uniforms when on duty. The material selected is cream colored Palm Beach cloth, plain, without stripes or figures. The caps are to be stiff, after the pattern of those worn by the petty officers of the U. S. Navy, and will be of the same color as the uniforms. They will have a device in front consisting of a partly closed wreath containing the word "Pilot". The coat will be a plain blouse, without braid, with stiff, standing collar, fastened by hooks and eyes, and will be provided with two upper pockets with button flaps. It will be fastened down the front with five buttons, all buttons to be of brass with the letters "C. P." on their face, removable, and held in place by lugs. The trousers are to be plain.

Detroit's Water Supply

President Livingstone, of the Lake Carriers' Association, has sent out the following circular to the boats, which is self-explanatory:

"The Detroit water board has presented the subject of the pollution of the drinking water of the city of Detroit to the consideration of the Lake Carriers' Association and after several conferences has made a request which is believed to be eminently within its rights, and that is, that no refuse shall be thrown overboard from vessels and that all toilets shall be closed within a reasonable distance of the intake of the city's water supply.

"The area which is bounded by a line drawn east and west 4 miles north of the present location of the Grosse Point lightship and a line drawn east and west from opposite the head of Belle Isle, is regarded as reasonable; or to define the area in another way—from the head of Belle Isle to Lake St. Clair gas and bell buoy 20-A, which marks the former location of the Grosse Point lightship. While the vessels of the association are within this area it is expected that all toilets will be closed and no refuse thrown overboard.

"It is understood that the passenger lines have given the Detroit water board assurance that they will respect the area defined above and, therefore, it is expected that no vessel enrolled in the association will pollute it.

"Masters should be instructed to observe this request."

Naval Constructor H. A. Evans, who recently resigned from the navy, has been elected vice president and general manager of the Skinner Shipbuilding & Dry Dock Co.

Campaign for Sanitation

Early in May the welfare committee of the Lake Carriers' Association addressed a letter to the dealers who supply the vessels with food stuffs urging that the utmost cleanliness be observed in handling provisions. This has now been supplemented with a letter addressed to the members of the association recommending that certain important essentials be observed aboard ship. The circular follows:

The welfare committee in its effort to fulfill its duties with respect to those matters which have been delegated to it by your body for consideration respectfully submit the conclusions and recommendations as outlined below.

These recommendations have been reached after numerous conferences and much thought and are the things which in its judgment should be actively adopted by all Lake Carriers' boats at this time. While there are other subjects which merit attention the idea of your committee has been to bring before you at this time only the more important, and trusts to the future to develop the scope. The present recommendations are along the line of sanitation. The committee does not wish to burden you with a dissertation on the benefits and necessity of this action. The benefits are sufficiently obvious as to need no argument; the necessity will be recognized by the careful student of the trend of economic thought.

The outline of the campaign for sanitation is as follows:

1. That dealers in food supplies be asked to co-operate.
2. That individual boats be asked to co-operate.

For the purpose of reaching the dealers a circular has been prepared of which the attached is a copy and which is self-explanatory.

It was decided to ask the co-operation of the boats on the following subjects:

Pure drinking water.
Sanitary water tanks.
Clean refrigerators.
Food free from contact with impure ice.
Sanitary handling of meats.
Dry bedding.

A few remarks are submitted as to the importance of each one of these subjects.

Water

The prevalence of dysentery, attributed to the taking of drinking water from those areas which are subject to the influence of shore sewage. An exhaustive report as to the areas where the water should not be taken has been issued by the United States government. These places are as follows:

Lake Superior

Duluth to abreast Two Harbors and with or after S. W. to N. W. winds Duluth to abreast Sand Island.

Soo River and Approaches

Whitefish Point, Lake Superior, to abreast Spectacle Reef, Lake Huron.

Lake Huron

Fifteen miles outside Ft. Gratiot light. With or after strong W. to N. W. winds Point Aux Barques to St. Clair river unless at least 10 miles off shore.

Lake Michigan and Straits

West or south of a point at least 12 miles off Milwaukee on Point Betsy course. With S. to N. W. winds, 25 miles off Milwaukee. Beaver Island to Spectacle Reef. If following west shore at least 10 miles off shore. With fresh S. E. to N. W. winds water may be taken under necessity only between Milwaukee and Chicago not less than 10 miles off shore.

River and Lake St. Clair and Detroit River and Approaches

Fifteen miles above Fort Gratiot light to 12 miles east of Southeast Shoal lightship. With or after brisk S. W. to N. W. winds, to 25 miles east of S. E. Shoal.

Lake Erie

Entire westerly end of Lake Erie to east of S. E. Shoal as above. Pt. Abino to Buffalo. At least 6 miles off shore and with or after S. to S. W. winds at least 12 miles. Area south of a line drawn from Kelley's Island to 12 miles off Erie is unsafe at any time.

But in addition to pure raw water it is obvious that tanks should be scrupulously clean. We, therefore, recommend, that it shall be the duty of one man on each boat to see that the tanks are cleaned each trip with soda and lye, using clean brooms or brushes, and that he alone shall have charge of filling them. All faucets in rooms should be opened to allow the solution to run through the pipes and afterward flushed with clean water. All tanks should be fitted with a screw plug on the outside of bottom of tank to permit of thorough drainage. All toilets aboard ship should be locked while water is being drawn for filling tanks.

All tanks should be filled through independent pieces of hose that are used exclusively for that purpose.

While these suggestions do not embrace all the things that could be recommended the committee believes them to be sufficient for the present and respectfully submits that they be insisted upon as a practice on the association's boats.

Ice

Artificial ice is pure. There is much natural ice, however, which is not. To guard against contamination of meats and milk from this source all ice should be absolutely kept in a separate compartment of the refrigerator, isolated completely from the compartment containing provisions and milk. Ice should not be put in drinking water. When not taken from the tank in the ice chest, drinking water should be kept in a clean bucket or pitcher in the refrigerator to be used as desired. Manufactured ice should be purchased wherever possible.

Refrigerators

Everything must be taken out of the refrigerator and the refrigerator thoroughly sterilized every trip.

Cleanliness of Cooks

Personal cleanliness in the galley should be promoted. Stewards should be instructed to see that the provision dealer is not allowed to put supplies in the refrigerator. This must be done by his own department.

Flies

Flies are dangerous. They help to spread typhoid fever, dysentery, etc., by infecting exposed food and water. Every effort should be made to keep them out.

Inspection

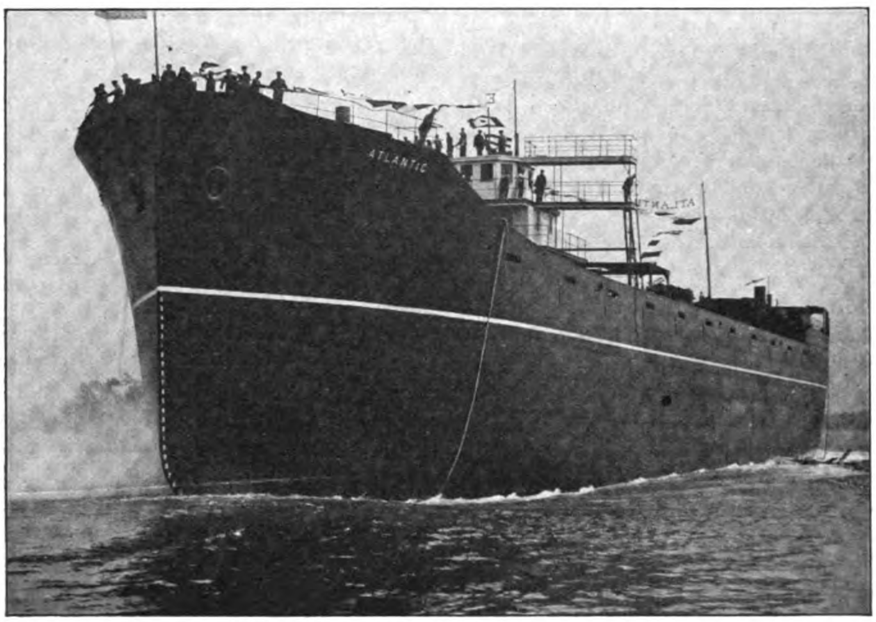
It should be the duty of the proper officer of the ship to inspect frequently the bedding on the boat to see that such bedding is sanitary and dry. Wet bed clothes are a common source not only of discomfort but of actual disease. Regular inspection should also be made of the galley, pantry, refrigerators, toilet facilities and all rooms occupied by the crew.

In conclusion, the committee asks the active co-operation of the individual boat with the dealers to attain the objects herein set forth. While existing conditions are probably no worse than the average of other employments, the observance of these rules will nevertheless make for greater efficiency and a higher standard of morale.

The Duluth office of the H. W. Johns-Manville Co. has moved to larger quarters at No. 327 West First street, in order to take care of its increased business. The new office is on the ground floor, with windows for the display of J-M asbestos roofing, pipe coverings, packings, sanitary specialties, auto accessories and other products of this company's well known and varied lines.

Bulk Cargo Carriers

The S. S. Atlantic, built at the yards of the Fore River Shipbuilding Corporation, Quincy, Mass., is the first of the duplicate vessels "Atlantic" and "Pacific" building for the Emery Steamship Co., of Boston. She is a steel screw steamer constructed with machinery aft to the design of George Simpson, naval architect, of New York City, and accorded the highest class in Lloyds registry. The vessel is designed to carry lumber and general cargo between ports on the Atlantic and Pacific coasts via Panama canal. The principal dimensions are as follows:



LAUNCHING THE ATLANTIC AT FORE RIVER FOR THE EMERY STEAMSHIP CO. OF BOSTON

Length over all, 405 ft. 9 in.; length between perpendiculars, 388 ft.; breadth molded, 54 ft. 4 in.; depth molded, 31 ft. 8 in.

The vessel has a straight stem, semi-elliptical stern and a single steel upper deck, full poop, bridge house amidships and top gallant forecastle.

Accommodations are provided in the midship house for the officers and wireless operator, with saloon, pantry, etc., and on bridge deck is the captain's suite and chart room, with the pilot house over same.

The long poop encloses quarters for the firemen, seamen and petty officers, and in the Liverpool house on the poop deck are arranged the quarters for the engineers, with officers' and engineers' mess, galley, etc.

The hull of this vessel is of the single deck type with a deep double bottom for water ballast extending all fore and aft from collision bulkhead to collision bulkhead. The cargo space is sub-divided by transverse watertight bulkheads into three cargo holds, each operated by large twin hatchways fitted with De Russett patent covers. The cargo holds are exceptionally large and practically free from obstructions, the only pillars fitted being one in the middle of each hold. The vessel is therefore well adapted for carrying lumber or bulk cargo such as coal, grain, etc. The inner bottom plating has been made exceptionally heavy to withstand the bumping of grab-buckets.

Arrangement will be made for carrying a large deck cargo of lumber and a port is fitted on each side through shell forward between the upper and forecastle decks for convenience in handling long logs.

The vessel will be rigged with three pole masts and two king posts, twelve 5-ton and one 25-ton derrick booms being fitted for handling cargo. The winches, nine in number, are of Lidgerwood Mfg. Co.'s make.

Steering gear, operated by telemotor, windlass and capstan of the most up-to-date type will be fitted.

The propelling machinery consists of a vertical, inverted, triple-expansion engine with cylinders 25, 41 and 68 in. diameter, having a stroke of 48 in., supplied with steam at 190 lbs. pressure from three single-ended, coal-burning, Scotch boilers, 13 ft. 9 in. diameter by 11 ft. 10 in. long, fitted with heated forced draft on the closed ash pit system. The propeller is of the built-up type having a cast iron hub and four cast steel blades.

A 25-ton evaporator will be installed, also a 1-ton refrigerating machine. The living quarters throughout the vessel will be provided with steam heat.

A complete electric plant will be installed consisting of a 15-k. w. General Electric Co.'s marine generating set with a combined generating and distributing switchboard, etc., complete, to supply current for one 18-inch searchlight and lighting system throughout the ship, including running and signal lights.

Fire Proof Oakum

By reason of having originated the different grades of plumbers' oakum, as well as being the first in the American field with machine spun marine oakum, the George Stratford Oakum Co. have earned the reputation of being the leaders in all new things in the oakum line.

This firm has now put on the market a product never before produced and but seldom, if ever before, thought possible—an oakum which is fireproof. It is the result of long experiments and fills a need long unsatisfied.

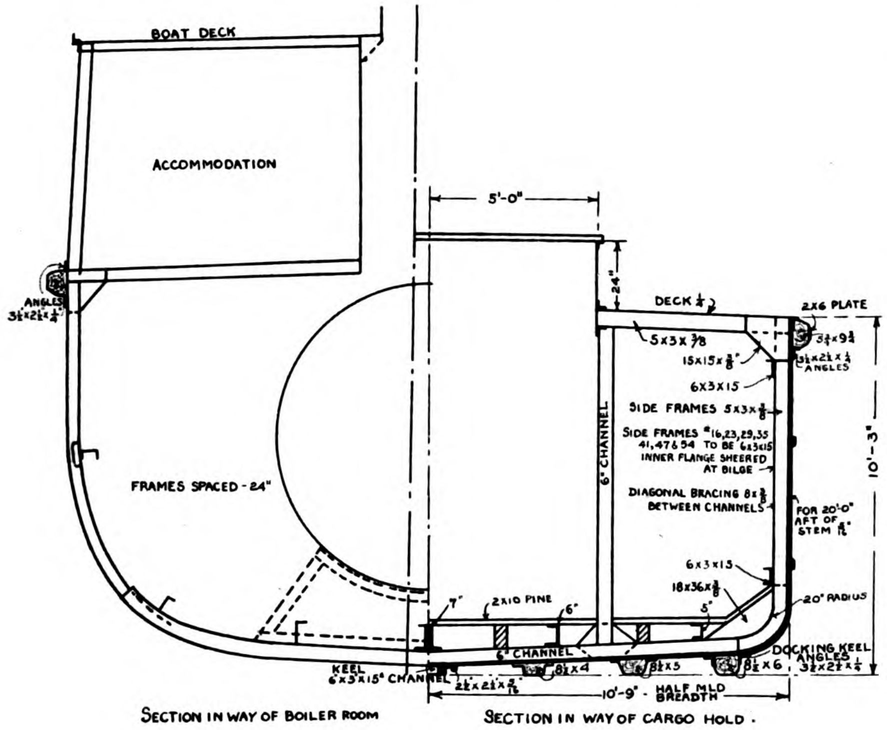
Oakum has been used for many years for the caulking of window frames to make them weatherproof. In fact, very few windows are absolutely weatherproof without its use. It has always, however, had the drawback of opposition, as many people would not want to put an inflammable or quick-burning material in frame, slow-burning or even fireproof buildings. Finally, the building department of New York City prohibited its use for this purpose in all buildings of nine stories and over, which buildings, according to the building code of that city, must be of fireproof construction. The window frames of such buildings, however, must be caulked to make them weatherproof, and Stratford's fireproof oakum is the answer.

The regular marine grades of oakum can be fireproofed by Stratford's process, but both the chemicals used and the process itself are necessarily expensive, and this cost added to the prices of the marine grades make this impractical. Besides this, the chemicals would partially, at least, destroy the preservative quality of the tar in these grades and this fireproofing has not therefore as yet extended into oakum for marine work.

The Maryland Steel Co., Sparrow's Point, Md., has been awarded contract for two new 12,000-ton colliers for the Panama canal, at a cost of $985,000 each. These vessels are to be of the same type of the eight colliers already built at that yard for the navy, and there will probably be four more similar vessels built for the canal.

Steam Lighters for Port Nelson

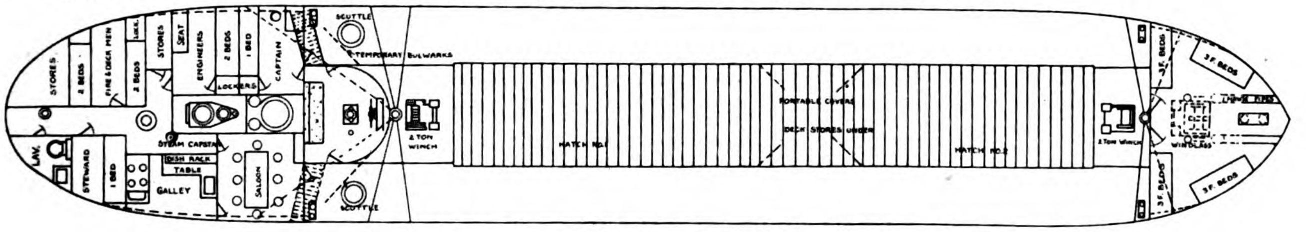
The Polson Iron Works, Toronto, is building three steel steam lighters for the Department of Railways and Canals, Dominion Government, for use at Port Nelson, Hudson Bay. The dimensions of these lighters are: Length, 128 ft.; beam, 21 ft. 6 in.; depth, 10 ft. They are of extra strong construction. The main engines are of the fore and aft compound surface condensing type with cylinders 10 and 22 in. in diameter by 16 in. stroke, supplied with steam from a Scotch boiler, 9 ft. in diameter by 9 ft. long, built for 160 lbs. working pressure. The lighters are equipped with feed, general service, sanitary and wrecking pumps, are electrically lighted throughout with search lights and are equipped with steam windlass, steam steering gear and two steam winches. Sleeping quarters, galley and cabin equipment are provided for a crew of ten men. Two of these lighters were launched on May 30. The launch was unique in Canadian ship building in that both boats were launched from the same ways, one following the other. The whole time from the starting of the launching of the first till the second lighter was afloat was eight minutes. The lighters will proceed under their own steam from Toronto to Port Nelson about June 15. These vessels were designed by, and built under the supervision of William Newman, works manager of the Polson Iron Works.

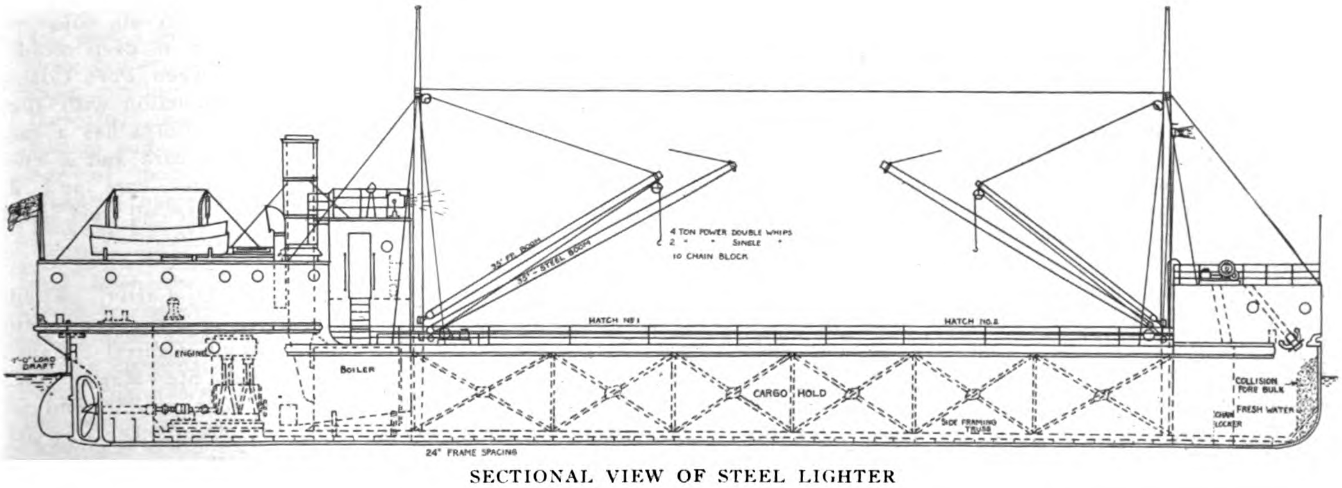


MIDSHIP SECTION OF STEEL LIGHTER

The tug Mariner, towing barges No. 11 and No. 15, left Cristobal at 6. a. m. Tuesday, May 19, and arrived at Balboa at 6:40 p. m., the same day. This is the first direct voyage from ocean to ocean by way of the canal. These barges are to be loaded with sugar transferred to them from the steamship Alaskan at Balboa and towed back to Cristobal. The Alaskan is a vessel of the American-Hawaiian Steamship Co.'s fleet, diverted to the Isthmus in consequence of the interruption of traffic on the Tehauntepec railway.

The Orient Line, Anderson & Co., 5 Fenchurch Ave., London, England, managers, has recently issued a poster calling attention to its service to Egypt, India, Australia and the Orient which is very attractive. It represents one of their liners entering the Suez canal on a still night with three Arabs clad in their picturesque garbs sitting on the bank. As a work of art it has great merit.





SECTIONAL VIEW OF STEEL LIGHTER

Contracts Under Maritime Law

Judge John M. Killits in the district court for the northern district of Ohio has just decided that the Ohio state employers' liability act (Norris act) is not applicable in an action brought for damages on account of personal injuries sustained by a seaman while employed under a maritime contract on a vessel on the great lakes.

The case was that of George Schuede, a wheelsman on the Saxona, against the Zenith Steamship Co. of Duluth. The steamship company was represented by Goulder, Day, White & Garry and the plaintiff by Newcomb, Newcomb & Chapman. In common with others who have defended ships on account of personal injuries received by seamen, Mr. Goulder has contended that the state legislatures have no authority to change the general maritime law. This contention was sustained in the district court at Buffalo in the case of the Henry B. Smith, but the present opinion of Judge Killits goes further and holds that irrespective of the form of action or the court in which relief is sought, the State employers' liability acts do not apply where the injury does not result in death.

Schuede was very badly injured while the vessel was moored in the river at Cleveland. Action was begun at law in the state court and was removed to the district court because of diversity of citizenship. The case was therefore treated as though it were still in the state court. The defendant pleaded that the plaintiff's employment, in the course of which he was injured, was under a maritime contract and that his rights of recovery in such an action are determinable by the incidents of such a contract. Counsel for plaintiff contended that he had the option of entering the state court and work out his rights by the law of the forum, enjoying whatever advantages he believed the state law offered to one complaining of injuries received in his master's service.

"It must be conceded," said the court, "that the plaintiff's employment was under a maritime contract. Both the general admiralty law and the statutory modifications treat, and have always treated those engaged as seamen, with particular favor and the law in admiralty defines with particularity the reciprocal duties and responsibilities of owner and crew, master and seaman. We agree with counsel for defendant that the principles of the general maritime law in force in the United States and not the subject of specific enactment by congress, are to be treated as if actually on the statute books. * * *

"A state may not pass any act which abridges or enlarges the responsibilities or duties of maritime law; rights in admiralty cannot be affected by state enactment. * * *

"The plaintiff proceeds on the theory that the law of Ohio applies against the Minnesota corporation and the Ohio jurisdiction attaches in the present case because the accident happened in an Ohio tributary to the lakes. There may be some doubt whether it is not the law of the Saxona's home port and the jurisdiction of Minnesota which control, if there is no federal law applying. * * *

"There are seven state jurisdictions bordering on the waters in which the Saxona plies and it is conceivable that seven seamen of the same class each might meet in his employment with an injury substantially of the same class in a port of each of such jurisdictions, each complainant enjoying a common right of recovery under the maritime law or a different right under the local law.

"Second, a seaman would enjoy the option of a uniform contractional right under the law maritime or to vary under local laws the incidents of the contract as he proceeds from port to port and as he had occasion to invoke such rights. In Buffalo his contract would be one thing; in Cleveland, if the Ohio law differs from that in New York, it would have another phase; it would change its color again in Detroit, Milwaukee, Duluth, Chicago and Michigan City if the laws of their several jurisdictions respectively offered peculiarities.

"These conditions with all their inconveniences and inequalites and unnecessary burdens are not compelled in the language of the savings clause in question and should be avoided in construing that provision. * * *

"In the case of a cause of action for an injury incurred in the course of maritime employment to avoid the manifest inconveniences and inequalities involved by the plaintiff's interpretation of the savings clause in question, it is not only reasonable, but well within the language of the law to require whichever court, state or federal, is entered to work out a remedy to enforce the general and uniform law maritime under which the contract of employment was made. * * *

"In admiralty no remedy exists for a death resulting from a maritime tort. In Cornell Steamboat Co. vs. Fallon, it was pointed out that the decedent, a seaman injured in the service of his vessel, had he lived to sue either at law or in admiralty, would have had his rights determined by the law maritime effecting his contract of employment whereas his administratrix was privileged to use the state law.

"Our conclusion is that the Ohio employers' liability act, commonly known as the Norris act, is not applicable to a maritime contract of employment and the motion to strike out should be overruled."

Changes in Suez Traffic

The Egyptian government has published the official figures for 1913 of the shipping which passed through the Suez canal. Statistics concerning the commerce of the chief competing countries in the Suez canal traffic follow, the increase or decrease on the corresponding figures for 1912 having been calculated in each case:

Flag.	Number of vessels. Total.	Number of vessels. Increase (+) or decrease (—).	Canal tonnage. Total.	Canal tonnage. Increase (+) or decrease (—).	Passengers carried. Total.	Passengers carried. Increase (+) or decrease (—).
British	2,951	—387	12,172,817	—963,486	139,512	— 6,763
German	778	+ 82	3,364,585	+334,774	31,791	+ 507
Dutch	342	+ 1	1,290,736	+ 52,799	18,362	+ 2,781
French	256	+ 35	931,128	+129,385	36,923	+ 8,177
Austro-Hungarian	246	— 1	849,168	+ 35,530	7,491	+ 1,764
Russian	110	— 16	341,941	— 24,746	12,098	— 5,954
Total, includ. all oth. flags	5,085	—287	20,214,856	—320,570	289,631	+29,020

In number of vessels and canal tonnage the various nationalities held in 1913 the same relative positions as in 1912 save that in the earlier year Austria-Hungary outranked France in both particulars. As to passengers, the order in 1913 was, as the above figures show, United Kingdom, France, Germany, Netherlands, Russia, and Austria-Hungary. In 1912 the order was United Kingdom, Germany, France, Russia, Netherlands, and Austria-Hungary.

The Contra Costa, the largest ferryboat in the world, was launched by the Southern Pacific Co. at its shipyard in West Oakland, Cal., May 16, and christened by Miss Kate Potwine, an employe of the company. This craft is 433 ft. long over all, 66½ ft. beam molded, 19 ft. 5 in. deep molded, and will ply between Port Costa and Bernicia in conjunction with the Solano. The Contra Costa has a capacity for 36 freight cars and 2 engines or 24 passenger cars and 2 engines. She will use oil fuel and is lighted by electricity.

The steamer E. D. Carter, owned by E. D. Carter, of Erie, has been sold to the Algoma Central Steamship Line, of Sault Ste. Marie, Ont. The Carter was built in 1906 and is 524 ft. over all, 504 ft. keel, 54 ft. beam and 30 ft. deep.